

RADIOLOGY

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RADIOLOGY

A MONTHLY PUBLICATION DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

PUBLISHED BY THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

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Henry Ford Hospital, Detroit 2, Mich.

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Cobalt-60 Beam Therapy in Carcinoma of the Esophagus¹

J. S. LOTT, B.A., M.D., D.M.R.T. (Eng.), AND IVAN H. SMITH, M.D., M.Sc., F.R.C.S. (Edin.)

THE DEVELOPMENT by Trump and Van de Graaff (1) of x-ray equipment in the 2- to 3-MEV range, and more recently the production of readily available high-energy sources of cobalt 60 by the Atomic Energy of Canada Limited (2), have been significant forward steps in the progress of radiation physics, radiation biology, and clinical radiotherapy.

The installation, in October 1951, of the first Atomic Energy of Canada Limited cobalt 60 beam-therapy unit in a treatment center of moderate size such as ours (Ontario Cancer Foundation London Clinic) placed upon us a responsibility, and presented a unique and challenging opportunity to be among the first to assess the effectiveness of this quality of nuclear radiation. We naturally looked forward to the possibility of its being more therapeutically effective by a considerable margin than conventional roentgen radiation in similar application. We have been so far sufficiently encouraged by the results of the first six years in the treatment of epidermoid carcinoma (3)—and not the least of epidermoid carcinoma of the esophagus—to report our experience with particular reference to those esophageal lesions treated radically, for cure.

Between January 1952 and December 1956 a total of 68 cases of carcinoma of the esophagus (Table I) were referred for

TABLE I: CARCINOMA OF ESOPHAGUS (1952-1956)
TREATED BY COBALT 60 BEAM THERAPY

	Cases
Treated for cure.....	31
Treated for palliation.....	28
Not treated or treatment incomplete.....	9
TOTAL.....	68

TABLE II: CARCINOMA OF ESOPHAGUS (1952-1956)
TREATED FOR CURE

Site of Disease	Number of Cases			
	Total	Squamous-cell Carcinoma	Adeno-carcinoma	Negative Biopsy
Postcricoid	6	6	0	0
Upper third	7	6	0	1
Mid third	13	11	0	2
Lower third	5	4	1	0
TOTAL	31	27	1	3

opinion and treatment. Of these, 31 were treated radically. The remaining 37 cases were treated palliatively, incompletely, or not at all.

The site of disease in the radically treated group is shown in Table II. In 25 of the 31 cases the disease was located in the thoracic esophagus. The remaining 6 have been designated "postcricoid," which probably represented the primary site, with extension to the cervical esophagus in all cases. All but 3 cases were proved malignant by biopsy.

In a series such as this, absolute accuracy in the estimation of extent of dis-

¹ From The Ontario Cancer Foundation London Clinic, London, Ontario, Canada. Presented at the Forty-third Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 17-22, 1957.

TABLE III: CARCINOMA OF ESOPHAGUS (1952-1956) TREATED FOR CURE

Extent of Disease	Number of Cases				Total
	Lesion 1-4 cm.	Lesion 5-8 cm.	Lesion 9-13 cm.	Lesion 14+ cm.	
Probably confined to esophagus	9	10	2	0	21
Probably local mediastinal extension	2	7	0	1	10
TOTAL	11	17	2	1	31

ease is an unattainable goal even with the most careful clinical and x-ray studies. Our estimate (Table III) of 21 cases apparently confined to the esophagus, in a total of 31 treated radically, must indeed seem liberal. Fleming (4) has stated that with lesions greater than 5.1 cm. in length more than 80 per cent will have accompanying lymph node metastases. In our radically treated series, 20 cases were judged on radiographic evidence to have lesions 5 cm. or more in length. The chance of obtaining a consecutive series of cases uncomplicated by the presence of even local lymphatic metastases must certainly be limited.

In assessing the accuracy of roentgen estimation of length of lesion Pettit (5) has shown, in a correlation of roentgen and autopsy findings, that in 25 of 35 cases the roentgen estimate was accurate to within 2 cm., while in 6 of the remaining 10 cases, the actual involvement was less than the estimate.

The Model A unit of the Atomic Energy of Canada Limited, was designed primarily for fixed-beam therapy. In 27 of the 31 cases treated radically, four, five, and six fields were used at 80 cm. source-to-skin distance, with the use of plaster-of-Paris casts in beam localization and fixation. All fields were treated daily. The remaining 4 cases were treated by circumaxial rotation therapy at 95 cm. source-to-tumour distance with a method of localization devised at our own center and described elsewhere (6).

In order to show the range of tumour dose in total treatment time, the volume

TABLE IV: CARCINOMA OF THORACIC ESOPHAGUS (1952-1956) TREATED FOR CURE
Fixed-Beam Therapy, Source-to-Skin Distance 80 cm.; 17 Cases

Year	No. Cases	Tumour Dose Range (r)	Total Time (weeks)	Volume Treated to Tumour Dose (cm.)
1952	6	High, 5,500	2½	Max., 17 × 6
		Low, 5,000	4	Min., 8 × 5
		Av., 5,000	3	
1953	5	High, 6,000	4½	Max., 12 × 5
		Low, 5,000	4	Min., 9 × 5
		Av., 5,500	4	
1954	2	High, 6,000	4	Max., 10 × 5
		Low, 5,800	4½	Min., 10 × 5
1955	0			
1956	4	High, 6,000	4½	Max., 12 × 7
		Low, 5,200	4	Min., 8 × 5
		Av., 6,000	4½	

TABLE V: CARCINOMA OF CERVICAL ESOPHAGUS (1952-1956) TREATED FOR CURE
Fixed-Beam Therapy, Source-to-Skin Distance 80 cm.; 10 Cases

Year	No. Cases	Tumour Dose Range (r)	Total Time (weeks)	Volume Treated to Tumour Dose (cm.)
1952	1	5,000	3	10 × 5
1953	2	5,000	4	12 × 7
		6,000	5½	8 × 5
1954	3	6,000	4	6 × 5
		6,500	5	10 × 8
1955	1	6,700	7	8 × 8
1956	3	6,200	4	10 × 5
		6,500	4½	10 × 5

TABLE VI: CARCINOMA OF THORACIC ESOPHAGUS (1952-1956) TREATED FOR CURE
Circumaxial Rotation Therapy, Source-to-Tumour Distance 95 cm.; 4 Cases

Year	No. Cases	Lung Corrected Tumour Dose (r)	Total Time (weeks)	Volume Treated to Tumour Dose (cm.)
1955	2	5,500	4½	12 × 6
		6,500	7	13 × 10
1956	2	5,500	5	13 × 8
		6,100	4½	11 × 10

treated, and the variation in tumour dose from year to year, the three Tables IV, V, and VI have been prepared.

In retrospect, it seems that our 1952 dosage of 5,000 r in three weeks (Table IV) produced too high a morbidity to warrant its continuation. By increasing the total

TABLE VII: CARCINOMA OF THORACIC ESOPHAGUS (1952-1953): FIXED BEAM THERAPY

Individual Cases by Site	No. Fields	Field Size	Tumour Dose Not Corrected (r)	Tumour Dose Corrected (r)	Total Time (weeks)	Actual Increase (r)	Per Cent Increase
Midthird	5	17 × 6	5,000	5,700	3	700	14
Midthird	5	15 × 7	5,000	5,800	3	800	16
Midthird	5	11 × 6	5,000	5,800	3	800	16
Upper third	4	11 × 7	5,500	6,300	2 $\frac{1}{2}$	800	15
Midthird	5	8 × 5	5,500	6,100	5 $\frac{1}{2}$	600	11
Midthird	5	12 × 5	5,000	5,300	4	300	6
Midthird	5	11 × 5	6,000	6,700	4 $\frac{1}{2}$	700	12
Lower third	4	12 × 5	5,500	6,400	5 $\frac{1}{2}$	900	16
Midthird	5	9 × 5	5,000	6,600	4	1,600	32
Upper third	4	10 × 5	5,500	6,500	4	1,000	18
Midthird	4	12 × 5	6,000	7,000	5	1,000	17
Average increase about.....						800 r	
Average per cent increase about.....						16 per cent	
Correction Factors (John C. F. MacDonald, M.A., Ph.D. Unpublished)							
Field traverses $\frac{1}{3}$ of its distance through lung:			Add 4% to % T.D.				
Field traverses $\frac{1}{2}$ of its distance through lung:			Add 8% to % T.D.				
Field traverses $\frac{2}{3}$ of its distance through lung:			Add 12% to % T.D.				

time to four or four and one-half weeks with tumour doses of 5,500 to 6,000 r, reactions became much more tolerable and results of treatment seemed equally good or better.

Tumour doses achieved in the cervical esophagus (Table V) were perhaps a little higher than in the thoracic region, but the variation from 1952 to 1956 followed approximately the same pattern. Our present aim in dosage would be to deliver 6,000 to 6,500 r in four to four and one-half weeks total treatment time to lesions in the cervical esophagus.

Experience with circumaxial rotation therapy to the end of 1956 was limited to 4 cases (Table VI). In contrast to the fixed-beam cases, dose calculation in the rotation group was corrected by transit dose measurements (7), which made allowance for increase in dose at the esophagus as a result of passage of the beam with minimal absorption through pulmonary tissue.

Observations in the rotation group with respect to increase in tumour dose resulting from transmission of radiation through pulmonary tissue led us to study a possible similar effect in those cases previously treated by fixed fields. Using a method of estimation outlined in Table VII we were rather amazed to find that the true esophageal tumour doses could be greater than originally calculated by as much as

32 per cent; actually, the average increase was about 16 per cent.

Tumour dose corrections are listed in Table VII for those cases treated radically during 1952 and 1953. On the basis of these and later observations, we concluded that for radical treatment, with both the fixed-field and rotational technics, we should attempt to deliver tumour doses, corrected for lung transmission, of 6,000 to 6,500 r in four to four and one-half weeks total time. This dose level would seem to be locally "tumour lethal" for squamous-cell carcinoma and does not appear to exceed the tolerance of normal esophageal tissues and their blood supply.

Treatment complications in the survivors have been remarkably few and minimal. One case of asymptomatic pulmonary fibrosis and one of mild stricture have been observed. A third patient whose disease prior to treatment had invaded the larynx and thyroid, continues to live in apparent comfort more than three and one-half years after treatment, with no evidence of recurrence but with a gastrostomy and tracheotomy which were already functioning at the commencement of therapy.

Length of survival in the radically treated cases is shown in Table VIII. Of the 21 patients who did not survive, excluding 3 still alive but with residual or recurrent disease, 12 lived five months or

TABLE VIII: CARCINOMA OF ESOPHAGUS (1952-1956): TREATED FOR CURE

Year	Total Cases	Survival Time					
		Died of Disease (months)				Alive with Disease	Alive and Free of Disease
		1-4	5-8	9-12	13-18		
1952	7	3	0	3	0	0	1
1953	7	3	1	0	0	0	3
1954	5	0	2	0	1	0	2
1955	3	1	0	1	1	0	0
1956	9	2	0	3	0	3	1
TOTAL	31	9	3	7	2	3	7

more and were considered to have obtained good palliation in spite of having had radical therapy.

The most serious complication associated with radical radiotherapy for carcinoma of the esophagus is mediastinal fistula. Whether radiation *per se* should ever be incriminated as the prime factor in the development of this complication is open to some doubt, for even an untreated carcinoma of the thoracic esophagus will sometimes, by insidious invasion, produce a spontaneous aortic perforation.

In our radically treated series this complication was seen six weeks after treatment in 1 case, and at three, ten, and twelve months respectively in 3 others. In the last 3 cases the perforation appeared to be the natural consequence of persistent deeply invasive local disease not materially affected by treatment.

In the first of the above 4 cases, persistent retrosternal pain was noted before treatment. In this patient a stenosing lesion developed in the region of the arch of the aorta. A tumour dose of 5,700 r, transit corrected, was delivered in three weeks, and the patient died six weeks later with a sudden and massive hemorrhage by mouth. At autopsy a malignant esophagoaortic fistula was discovered.

More recently we have observed a patient who complained almost constantly of retrosternal pain radiating into the epigastrium before, during, and after treatment of a carcinoma of the lower third of the esophagus. Even without radiographic confirmation of a suspected incipient mediastinal fistula, we were sufficiently suspicious of its presence to limit dosage to a safe palliative level. At autopsy, a

penetrating malignant ulcer of the esophagus was found just above the cardio-esophageal junction. It had eroded the full thickness of the esophageal wall, and a fistula led into the left pleural space. Persistent retrosternal or back pain is strongly suggestive of deep penetrating ulceration of the esophagus.

In a recent publication, Steiner (8) has described 9 cases of asymptomatic carcinoma of the esophagus found incidentally at autopsy. In almost all cases there was extension of the disease to the submucosa. In 4 cases the muscle layers of the esophagus were involved, and in 2 of these regional lymph nodes were invaded by the disease. If such invasive qualities are characteristic of this disease in its asymptomatic stage, one marvels that any survivors are encountered when the patient delay from onset of symptoms to diagnosis averages four to six months.

In view of the foregoing observations, our series of 7 patients (Table IX) alive and apparently free of disease for periods ranging from one to five years seems so gratifying as to evoke the response "fortuitous" even from ourselves. The fact remains that these are not all five-year survivors; and yet as we watch them from month to month, realizing that most of the failures either died or had recurrence within the first year, we are encouraged to think that the results are a significant improvement in comparison with conventional x-ray therapy.

The pertinent treatment data on the 7 disease-free survivors are summarized in Table IX. It is worth noting that the disease was judged on clinical grounds to be confined to the esophagus in 5 cases.

TABLE IX: CARCINOMA OF ESOPHAGUS (1952-1956) TREATED FOR CURE: SURVIVORS FREE OF DISEASE

Site	Length of Lesion (cm.)	Pathology	Tumour Dose Not Corrected (r)	Tumour Dose Corrected (r)	Total Time (weeks)	Survival (months)
Upper third	2	Leukoplakia	6,000		4 $\frac{1}{2}$	12
Midthird	5	Negative	5,800	6,800	4 $\frac{1}{2}$	33
Postericoid	6	Squamous-cell	6,500		5	44
Lower third	12.5	Squamous-cell	5,500	6,400	5 $\frac{1}{2}$	45
Midthird	5	Squamous-cell	5,000	6,600	4	46
Postericoid	4	Squamous-cell	6,000		5	52
Midthird	4	Squamous-cell	5,000	5,800	3	60

In 1 of the remaining cases, there was extension to the larynx and pretracheal lymph nodes, yet the patient survived forty-four months without apparent disease. In the other, surviving sixty months, thoracotomy before therapy revealed an inoperable lesion attached to the aorta.

Five of the 7 cases were biopsy-proved squamous-cell carcinoma. In the 2 cases without histologic proof there was definite radiographic and clinical evidence of persistent stenosing esophageal lesions fully compatible with cancer. It is worthy of note that in 6 cases the tumour dose range, corrected for transmission through pulmonary tissue, was 6,000 to 6,800 r in four to five and one-half weeks. In the remaining case, the tumour dose was 5,800 r delivered in three weeks, which probably can be considered biologically equivalent to the others.

SUMMARY

1. In our experience, cobalt-60 beam therapy is proving to be a more effective method of managing squamous-cell carcinoma of the esophagus than conventional x-ray therapy.

2. Tumour doses of 6,000 to 6,500 r, corrected for lung transmission, in four to four and one-half weeks overall treatment time, seem to be both safe and desirable in any serious attempt to salvage curable cases by this method of treatment.

3. Persistent retrosternal or back pain is strongly suggestive of penetrating ulceration of the esophagus.

4. Methods of obtaining an estimate of the true tumour dosage, allowing for increased absorption at the esophagus due to transmission of the beam through pulmonary tissue, have been referred to.

5. Seven patients, in a total of 31 treated radically, are alive and apparently free of disease for periods ranging from one to five years.

Victoria Hospital
London, Ontario

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SUMMARIO IN INTERLINGUA

Therapia A Fasce De Cobalt 60 In Carcinoma Del Esophago

Le autores reporta lor experientia con le apparatus de therapia a fasce de cobalt 60 del Commission pro le Energia Atomic

de Canada, installate in 1951 in le Clinica London del Fundation contra le Cancer de Ontario, con referentias particular

cancere esophagee tractate radicalmente con le objectivo de curation. Illes ha trovate iste methodo plus efficace in le tractamento de cancre del esophago que le roentgenotherapia conventional. Lor serie de patientes consiste de 31 individuos. Ex istes, 7 esseva vive e apparentemente libere de morbiditate a periodos de un a cinque annos post le tractamento.

Therapia a fasce fixe, a transverso inter quatro e sex campos esseva usate in 27 casos; therapia a rotation circumaxial esseva usate in 4 casos. In omne casos le objectivo del tractamento esseva le curation del patiente.

Doses al tumor amontante a 6.000 a 6.500 r, corrigite pro transmission pulmonar e applicate in le curso de un total

tempore tractamental de quatro a quatro e medie septimanas, pare esser salve e desirabile in un serie effortio a salvar curabile casos per iste methodo therapeutic.

Es mentionate methodos pro le obtention de estimationes del ver dosage al tumor, prendente in consideration le augmentate absorption post transmission del fasce a transverso le histos pulmonar.

Le plus serie complication associate con radiotherapia radical pro carcinoma del esophago es perforation e le formation de un fistula mediastinal. Tamen, isto pote esser un consequentia natural del invasion profunde del morbo local. Le symptoma persistente de dolores retrosternal o dorsal comporta un forte suggestion de ulceration penetratori.



Intensive Cobalt-60 Teletherapy of Lung Cancer¹

EUGENE R. KUTZ, M.D.

THE FACT THAT bronchogenic carcinoma can seldom, if ever, be cured by irradiation has rarely been disputed. There are many factors which account for the failure of radiation to cure carcinoma of the lung. The most important of these are as follows:

1. Bronchogenic carcinoma is usually invasive by nature, and, because it is growing in an organ which is extremely vascular, it invades the blood and lymphatic channels early, often producing metastases before detection of the primary tumor.

2. Bronchogenic carcinomas are generally radioresistant. Undifferentiated carcinomas often have been classified erroneously as radiosensitive tumors. They are more correctly classified as radioresponsive, since they respond promptly but usually have invaded the blood and lymphatic channels before they are controlled locally, and thus are never cured.

3. Patients with bronchogenic cancer have often so deteriorated before the diagnosis is made that they are unable to tolerate cancerocidal tumor doses.

4. The lung tolerates radiation poorly, and a tumor dose which is cancerocidal for a pulmonary neoplasm is often sufficiently high to produce irreparable damage to the normal tissues overlying and surrounding it.

Since the nature of the disease and the bed in which the tumor is growing cannot be altered by any means at present at our disposal, the only hope of improving the results of treatment in bronchogenic carcinoma lies in an attempt to deliver a cancerocidal dose to the neoplasm without producing critical damage to the surrounding tissues and to the host himself. Cobalt teletherapy and supervoltage x-ray therapy have a better chance of accomplishing this than radiation of lower energy. Percentage-wise, the improvement in statistics thus

attained would be small, since treatment failures are seldom due to insufficient dose alone. Any improvement, however, is significant, considering the hopelessness of inoperable carcinoma of the lung at the present time.

In 1956, the writer of this paper compiled statistics on all patients receiving 400-kv x-ray therapy for bronchogenic carcinoma between March 1, 1952, and March 1, 1955, in the Radiation Therapy Department of Allegheny General Hospital. These statistics have been reported elsewhere (8). In summary, 50 histologically proved cases were reported. Twenty patients had lesions which were undifferentiated, 18 had well differentiated squamous-cell lesions, 9 histologically proved malignant tumors of unknown cell type, and 3 adenocarcinomas.

Analysis of the undifferentiated group showed an average survival time of only 4.7 months, and no patient lived as long as a year following the initiation of x-ray therapy. The squamous-cell group, comprising 18 patients, had an average survival time of 11.4 months at the time of the report, and 53 per cent of the patients had lived over one year. The average survival time for the group has now increased to 14.7 months because of the long survival of one patient since the original study.

The total dose varied, depending upon the condition of the patient, but the average tumor dose for undifferentiated carcinoma was less than 4,000 r, while that for squamous-cell carcinoma averaged about 4,500 r.

Since this series was reported, all patients have succumbed to their disease; the patient with the longest survival lived fifty-six months.

The patients treated with 400-kv x-ray therapy were generally preselected. Al-

¹ From the Department of Radiology, Allegheny General Hospital, Pittsburgh, Penna. Accepted for publication in February 1958.

though they had inoperable and therefore reasonably far advanced disease, they were generally in fair or good general condition when referred by the Department of Thoracic Surgery for irradiation.

In January 1955, a 1,500-curie cobalt-60 teletherapy unit was installed in the Department of Radiation Therapy. After the installation of this unit, all patients with lung cancer referred to the department received cobalt teletherapy. This number included patients with residual tumor after partial resection, patients in whom the tumor was considered nonresectable at the time of thoracotomy or before thoracotomy, and patients who refused surgery. Only terminal cases were rejected. About half of those treated had tumors which had been found at thoracotomy to be nonresectable. Though the disease was confined to the thorax in these cases, there was in most instances extensive mediastinal or hilar involvement, which the thoracic surgeon felt was technically nonresectable. In a few patients the surgeon was able to resect the tumor within the lung but found residual growth within the mediastinum, which had to be irradiated to be controlled. There was also a group with disease of the cervical or supraclavicular nodes proved by biopsy. These cases were generally classed as nonresectable and referred to us without thoracotomy for treatment of both the lung lesions and the involved nodes. Very few patients in this series were known to have distant metastases when treatment was started. Irradiation in these few instances was solely for palliative reasons and was discontinued when palliation was achieved.

The only patients who might have had surgically curable lesions were the few in whom thoracotomy was impossible because of their refusal to submit to operation, or in whom thoracotomy was contraindicated by serious cardiac or respiratory disease. Thus, the majority of patients treated by us were those in whom thoracotomy was performed but the tumor was found to be nonresectable or in whom there was definite

evidence of nonresectability before surgery was attempted.

Our tumor doses varied from 5,000 to 7,000 r for squamous-cell carcinoma, whenever possible. During the first six months undifferentiated lesions received a like dose, but because early metastases were encountered so frequently, this was reduced to less than 5,000 r.

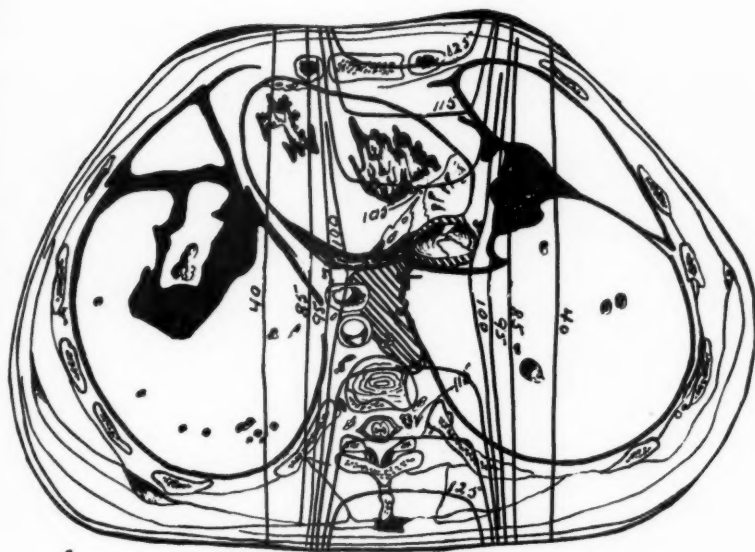
TREATMENT PLANNING

The treatment plan varied with the location of the lesion, its size and shape, and size of the patient.

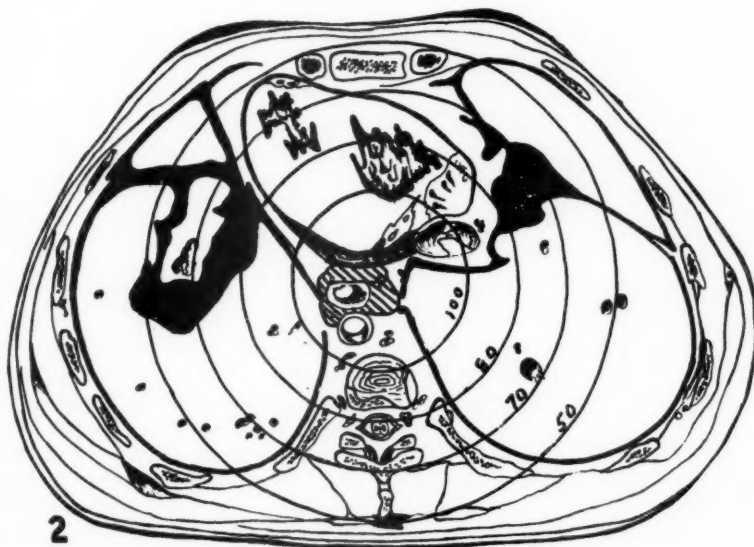
Whenever the anteroposterior diameter of the chest was less than 20 cm., anterior and posterior opposing fields were utilized. This treatment plan was also adopted for patients having lesions which were of short lateral diameter but long anteroposterior diameter (Fig. 1). With lesions of this shape, when anterior and posterior opposing fields were used, they could be kept relatively small. If, on the other hand, a rotational technic were applied, it would be necessary on account of the long anteroposterior diameter to enlarge the ports significantly to cover the lesion whenever the radiation source was in the lateral position. Relatively small lesions situated close to the center of the thorax were especially suitable for complete rotational therapy. In these patients tumor doses in excess of 7,000 r could be delivered without producing any significant damage to the overlying skin and a minimum to the overlying and surrounding tissues (Fig. 2).

In patients with lesions situated peripherally, rotational cycling was found to be sufficient to deliver tumor doses of 7,000 r without producing significant skin damage. The lung on the normal side is also spared. The size of the cycling arc varied, depending upon the location of the tumor. Occasionally the arc was less than 180°, usually it varied between 180 and 210° (Fig. 3).

Perhaps the most difficult lesion to treat by any method was the large lesion requiring a field of 225 sq. cm. or more, since a large volume of the overlying and



1



2

Fig. 1. Diagram of the cross-sectional anatomy of the lower thorax, showing the isodose lines for opposing anterior and posterior 10×15 -cm. fields directed at a mediastinal tumor (cross-hatched area). Each isodose line is designated as a percentage of the tissue dose at the axis. The axis is located in the center of the cobalt beam 75 cm. from the source. This treatment plan is adaptable to lesions which are narrow when viewed in the anteroposterior diameter but of considerable size when viewed in the lateral projection. It is also adaptable to patients with small anteroposterior measurements.

Fig. 2. Cross-sectional diagram of the lower thorax demonstrating the isodose lines for a 10×15 -cm. field completely rotated around the thorax. The tumor is shown encircling the esophagus (cross-hatched area). The isodose lines again show the percentage of the tissue dose at the axis of rotation. The location of the axis is at the center of the circular isodose lines. This treatment plan is especially adaptable to relatively small lesions located centrally in the thorax. Radiation pneumonitis in the centralmost portion of both lung fields is common with this treatment plan because of the relatively high dose delivered here. Because extensive bilateral radiation pneumonitis may be a fatal complication, this treatment plan should be reserved for small fields. Its great advantage is that it spares the skin and the spinal cord when compared with the treatment plan shown in Fig. 1.

Figs. 1 and 2 modified from Eycleshymer and Shoemaker: A Cross-Section Anatomy, published by Appleton-Century-Crofts, Inc., New York, N. Y.

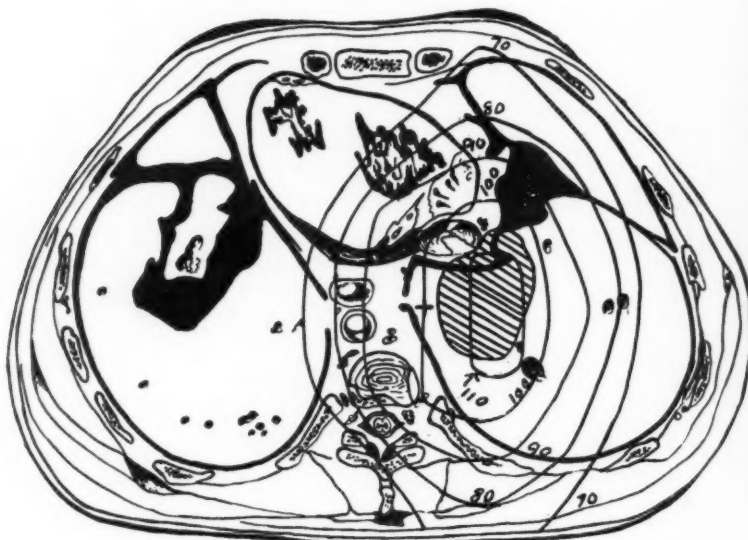


Fig. 3. Diagram of the cross-sectional anatomy of the lower thorax showing the isodose lines for a 10 X 15-cm. field which is rotated through an arc of 180° around the right side of the thorax. The tumor is shown as a cross-hatched area in the right lung. The isodose lines are expressed as a percentage of the tissue dose at the axis of rotation, which is shown as a cross just medial to the tumor, intersected by the 100 per cent isodose line. Locating this axis of rotation medial to the tumor insures the highest dose at the tumor. If the axis of rotation is centered directly on the tumor, its medial portion receives between 80 and 90 per cent of the axis dose and, more seriously, the normal lung lateral to the tumor receives 110 per cent of the axis dose; by moving the axis of rotation medial to the tumor one is able to deliver the maximum dose into the tumor itself. This plan has the additional value of sparing the normal lung on the opposite side. It is especially suitable for lesions situated in the parenchyma of the lung on either side.

Modified from Eycleshymer and Shoemaker: *A Cross-Section Anatomy*, published by Appleton-Century-Crofts, Inc., New York, N. Y.

surrounding tissue also received a high dose. This usually produced rather marked radiation changes in the lung, which were frequently contributory to the patient's death.

COMPLICATIONS

The complications of intensive cobalt-60 teletherapy to the lung were much like those encountered with x-ray therapy. They were, however, of different intensity.

Radiation sickness occurred in patients treated with cobalt almost as frequently as in the x-ray series, but its severity appeared to be less. Many patients treated with cobalt did not have radiation sickness despite high total doses, and a small percentage were able to continue working during treatment while a few even showed a gain in weight. Only occasionally was a patient's treatment interrupted because of radiation sickness, whereas this was fre-

quently necessary in the group treated with x-rays.

Esophagitis seemed to occur more frequently with cobalt-60 teletherapy than with conventional radiation therapy. This complication was especially noticeable when the esophagus was near or in the tumor and had to be included in the treatment beam. The higher incidence of esophagitis in the cobalt group was probably due to the fact that the amount of radiation delivered to the esophagus was greater than with conventional therapy; thus, the esophagus frequently received doses equal to the tumor dose.

Skin reactions were practically nonexistent in those lesions which were amenable to rotational therapy. Only when two opposing stationary portals were used was the skin reaction significant because of the contribution from the exit dose of the opposite field. The usual effect was an

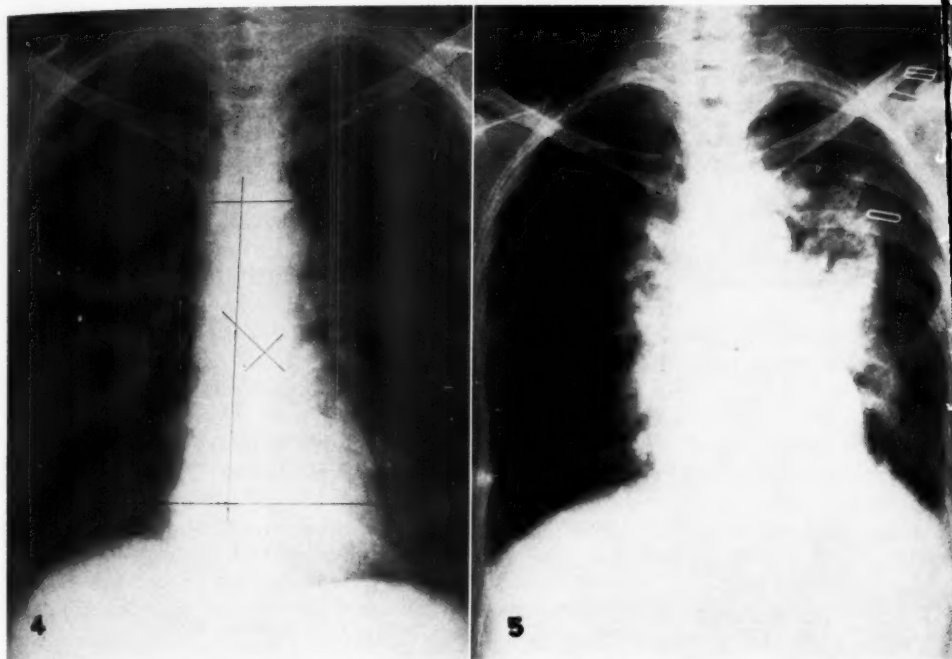


Fig. 4. Roentgenogram of the chest demonstrating a tumor in the left hilus and left lower lobe with questionable tumor in the right hilar area. The lines drawn on the film show the limits of a 15 X 15-cm. field.

Fig. 5. Film of the same chest taken approximately two months following the completion of treatment to the field shown in Fig. 4. The tumor dose to this field did not exceed 4,200 r. Note the sharply defined areas of radiation pneumonitis corresponding closely to the field marked on Fig. 3.

erythema with dry desquamation. Treatment of the skin reaction was seldom necessary even in the most severe cases.

Radiation pneumonitis was one of the most serious complications encountered. It occurred in almost every case to a greater or lesser extent, manifesting itself from one to six months after treatment. It usually continued until fibrosis and atelectasis of the involved lung occurred. The seriousness of this complication was more dependent upon the volume of tissue treated than it was upon the dosage. With small lesions adequately covered with a 100-sq. cm. field, radiation pneumonitis was seldom a problem even when doses of 7,000 to 8,000 r were given; on the other hand, when it was necessary to treat a lesion through a field of 225 sq. cm., pneumonitis was frequently a serious complication even at dosage levels around 4,000 r (Figs. 4 and 5). Radiation pneumonitis appeared to

be a more serious problem than it had been with x-rays, but this was probably due to the consistently higher doses.

RESULTS OF TREATMENT

In November 1957, the statistics on all patients treated for lung cancer during the calendar years 1955 and 1956 were compiled. One hundred and eighty-nine patients with lung cancer had been treated by cobalt-60 teletherapy during these two calendar years. One hundred and eighty-two of these were followed regularly in the department or by correspondence when they were too far away for personal follow-up. The histologic distribution of the tumors is summarized in Table I. Nineteen of 182 patients had clinical and roentgenographic evidence of carcinoma, but no histologic proof. In none of these could histologic proof be obtained by any pro-

TABLE I: HISTOLOGIC DISTRIBUTION OF COBALT-60 SERIES*

Type	Total	Living	Dead
Squamous-cell	82	15	67
Undifferentiated	43	4	39
Malignant, unknown cell type	18	3	15
Adenocarcinoma	9	0	9
Clinical diagnosis	19	2	17
Other	2	0	2

* Nine cases were incompletely treated and therefore excluded from this and the following tables.

cedure short of diagnostic thoracotomy, and this was either refused or the patients were considered unsuitable candidates for the procedure. These cases were at first eliminated from the series, but when they were reinserted the statistics did not change significantly; therefore, because most of them in all probability had bronchogenic carcinoma, it was thought best to include them in the final analysis.

Twenty-four persons treated during the years 1955 and 1956 were still living in November 1957. Thirteen were clinically and roentgenographically free of disease. Four had no definite clinical or roentgenographic proof of remaining disease, but it was felt that there was a good probability that it still existed. Five still had evidence of disease. One had recurrence of tumor in the lung adjacent to the primary lesion. This has been treated and the disease appears to be arrested at the present time. One patient is living but it is not known whether with or without evidence of disease.

When our statistics concerning the treatment of lung cancer with 400-kv x-ray therapy were published, there appeared to be definite evidence that the prognosis in squamous-cell carcinoma treated with radiation was far better than that of undifferentiated carcinoma. This is confirmed by the fact that of 24 living patients treated with cobalt 60, 15 had proved squamous-cell lesions while only 4 had proved undifferentiated lesions; thus, although the squamous-cell group was less than twice as large as the undifferentiated group, the number of patients with squamous-cell carcinoma surviving after the first two

years of treatment is four times the number with undifferentiated carcinoma. Twenty-one of the 24 living patients are alive more than one year following treatment, and 8 have survived over two years.

The cobalt series, like the 400-kv series, fails to show any good correlation between dosage and survival. It would seem significant that most of the living patients received more than a 5,000 r tumor dose, but this greater longevity could be due to the fact that these patients received larger doses only because they were in better general condition. It is reasonable to suspect that they might have lived longer than the other patients even if they had not been treated. Table II shows the percentage of the patients surviving for six months, twelve months, and twenty-four months in each histologic group.

TABLE II: SURVIVAL PERIODS ACCORDING TO HISTOLOGIC TYPE

Type	Total	% 6 Mo. Survivals	% 12 Mo. Survivals	% 24 Mo. Survivals
Squamous-cell	82	58.5	28	8.5
Undifferentiated	43	55.8	11.7	2.2
Malignant, unknown cell type	18	50.0	22	5.5
Adenocarcinoma	9	33.3	0	0
Clinical diagnosis	19	68.4	31	15.8
Other	2	50.0	50	0

When the statistics on the patients still living are combined with those for the dead, it is found that 41 of 173, or 24 per cent of the total, survived one year or more following the initiation of treatment, while 12, or 7 per cent, survived two years. The statistics are based on a total of 173 patients because, in addition to the 7 on whom we could obtain no follow-up, there were 9 who received only token doses of radiation and, therefore, were unsuitable for evaluating results.

The average survival time at present for patients with squamous-cell carcinoma is 9.8 months following treatment. This figure is bound to increase with time, since 15 squamous-cell carcinoma patients are still living, and, as their survival times con-

TABLE III: RESULTS OF TREATMENT OF BRONCHOGENIC CARCINOMA AS REPORTED BY VARIOUS AUTHORS

Reporter and Year	No. of Cases	6 Months Survivals		12 Months Survivals		24 Months Survivals		Average Survivals (in Months)			Type of Irradiation
		No.	%	No.	%	No.	%	Un-diff.	Squam.	All	
A 1955	100	63	63	27	27	11	11	..	..	..	2 MEV
B 1944	41	17	41	6	14	2	5	..	..	8.6	250 kv
C 1957	385	137	35	57	15	17	15	..	..	4.0	250 kv
D 1957	143	..	..	16	11	..	..	..	..	..	250 kv
D 1957	47	..	..	10	21	..	..	..	..	..	Betatron
E 1957	200	68	34	17	9	3	2	..	..	..	250 kv and MEV
F 1952	125	45	36	22	18	4	3	5.5	7.1	6.6	250 kv
G 1943	27	..	..	2	8	0	0	..	..	7.3	1 MEV
Kutz 1956	50	20	40	9	18	2	4	4.7	14.7	8.6	400 kv
Present Series	173	99	57	41	24	12	7	7.2+	9.8+	8.6+	Cobalt 60

time to lengthen, the average for the total number treated will also become longer. This average survival time may equal, if not exceed, the average survival time obtained by treatment with 400-kv x-rays.

The average survival time for patients treated for undifferentiated carcinoma is 7.2 months. This includes both the living and the dead, and this figure, too, should increase if the patients who are now living survive for any length of time. This survival period is a significant improvement over that obtained with 400-kv radiation, which was only 4.7 months.

One case which came to autopsy demonstrated the effectiveness of intensive radiation therapy in sterilizing a squamous-cell bronchogenic carcinoma. The patient was admitted to another hospital with what appeared to be an operable lesion of the left lower lobe. Bronchoscopic examination and biopsy revealed a squamous-cell lesion. Three attempts at resection were made but each time the patient was unable to tolerate anesthesia because of a perilous cardiac condition. Further attempts at pneumonectomy were abandoned and the patient was referred for cobalt-60 teletherapy. Fourteen months following treatment, death occurred from cardiac disease. An autopsy revealed no evidence of carcinoma in either lung, but the pathologist felt that death was due to a combination of cardiac and respiratory disease, with radiation fibrosis contributory to the latter. The tumor had received 6,000 r in thirty-nine days.

DISCUSSION

The statistics which have been presented above represent two years experience in the treatment of bronchogenic carcinoma by means of cobalt-60 teletherapy. Following the compilation of these figures, the literature was scanned for similar series. Those shown in Table III were found to be the most comparable to our own. They have been compiled in institutions comparable in size to Allegheny General Hospital, and the authors express their results in terms comparable to our own. Many other reports have been published, but frequently the period of survival represents the time between onset of symptoms and death or the time between diagnosis and death. In the series listed in Table III, including our own, survival means survival following treatment. The type of radiation therapy varied in these series. This gave a good basis for comparison of the results with radiation in different energy ranges.

From this table, it is concluded that our results with cobalt were generally better than those obtained by radiation in the lower energy ranges. The only series equal to or better than our cobalt series was that reported by author A (4), who treated all of his patients with two-million-volt x-rays, an energy range comparable to cobalt-60 teletherapy. The results in our 400-kv series are poorer than with cobalt when one compares the six, twelve, and twenty-four month survivals, but the average survival time in some of the histologic groups, as well as the average overall survival to date, is comparable to that following cobalt

therapy. Unfortunately, the statistics for the patients receiving 400-kv radiation are final and cannot improve. In the cobalt series the average survival time for the undifferentiated group, the squamous-cell group, and consequently the overall average survival time, will unquestionably continue to increase, since 24 patients still survive.

The authors who reported results with 250-kv therapy generally showed poorer survival statistics than were obtained with cobalt and two-million-volt therapy. This it would appear is reasonable to expect, since there must be a certain group of lesions which will respond to a higher dose than can be given with radiation of lower energy. Unfortunately, author D, in reporting a small series treated with the betatron, mentions only the one-year survival statistics which compared favorably with those with cobalt and two-million volt x-ray therapy. Because of the small size of this series and the lack of further statistics, it is difficult to compare the results in the treatment of carcinoma of the lung by the betatron with cobalt-60 teletherapy.

SUMMARY AND CONCLUSION

From the statistics presented above and their comparison with those reported by other authors, it seems that better results in the treatment of bronchogenic carcinoma can be obtained with higher energy radiation than with radiation of lower energy. This improvement is probably due to the relatively small group of localized tumors which will respond to high dosage. Since it is possible to deliver higher tumor doses with cobalt and supervoltage therapy than with lower energy radiation, the former type of treatment results in better survival statistics.

NOTE: The author wishes to express his thanks to Miss Frances Korherr and Mr. Thomas Snell for the art and photographic work on Figures 1, 2, and 3.

Allegheny General Hospital
Pittsburgh 12, Penna.

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SUMMARIO IN INTERLINGUA

Intense Teletherapia A Cobalt 60 in Cancere Pulmonar

Le autor reporta le resultatos obtenite per ille con intense therapia a cobalt 60 in un serie de 173 inoperabile cancers pulmonar e compara su statisticas con illos in un studio anterior de patientes qui recipeva roentgeno-irradiation a 400 kv. Le tractamento esseva planate secundo location, dimension, e configuration del lesion. In alicun casos, campos opposite antero-posterior esseva usate, e in alicunes un technica rotational esseva empleate. Esseva constatate que doses de 7.000 r e plus al tumor poteva esser administrate sin producer ulle grado significative de damno al pelle superjacente.

Le complicationes includeva morbo de radiation (ben que apparentemente minus sever que in le caso de roentgeno-irradiation a 400 kv), esophagitis (de occurrentia plus frequente que in le serie a roentgeno-irradiation), e pneumonitis radiational (presente in un certe grado in quasi omne caso).

Vinti-quattro del patientes tractate in 1955 e 1956 viveva in novembre 1957. Dece-tres de illes esseva clinicamente libere de symptomatas. Quaranta-un patientes con carcinoma a cellulas squamose amontava—usque al tempore del reporto—a 9,8 menses. In le gruppo con carcinoma non-differentiate, illo esseva 7,2 menses.

Quando iste datos es comparate con illos reportate per altere autores in comparabile series de casos, il pare que melior resultatos in le tractamento de carcinoma bronchigene pote esser obtenite con radiation a plus alte energia que con radiation a plus basse energia. Iste melioration es probabilemente a explicar per le relativamente micre gruppo de tumores localisate que responde a un alte dosage. Proque il es possibile administrar plus alte doses al tumor per medio de cobalt e de therapia a supervoltage iste typo de tractamento resulta in un melior statistica de superviventia.



Radiographic Chest Examination of the Tuberculous Patient¹

ANTON M. PANTONE, M.D.

THIS REPORT is based on experiences with patients who were admitted to the Chicago State Tuberculosis Sanitarium during the period Nov. 9, 1953, through June 30, 1957. A total of 14,446 varied chest examinations were performed. These can be divided as follows:

- 12,024 routine chest examinations (postero-anterior and lateral)
- 1,266 laminagraphic examinations
 - 362 lateral laminagraphs
 - 904 anteroposterior laminagraphs
- 416 bronchographic examinations
- 720 stereoscopic chest examinations
- 20 apical-lordotic studies

ROUTINE CHEST EXAMINATION

Upon admission each patient is subjected to a routine postero-anterior and lateral chest examination. Follow-up progress

studies are obtained in four to six weeks depending upon the specified case. The technic is of the so-called high-kilovoltage type: 125 kvp, the mas varying with the patient's size. A grid cassette is utilized in these cases. The advantages of this technic have been adequately described by other workers (1).

A conventional film (lower kilovoltage range) was also obtained upon patients admitted to the institution from November 1953 through December 1954. This conventional film was compared with the high-kilovoltage film and, with all details considered, it was felt that the latter gave a higher "yield" of lesions. It was also remarkable that films in various studies upon the same patient had a very similar technical appearance, prac-

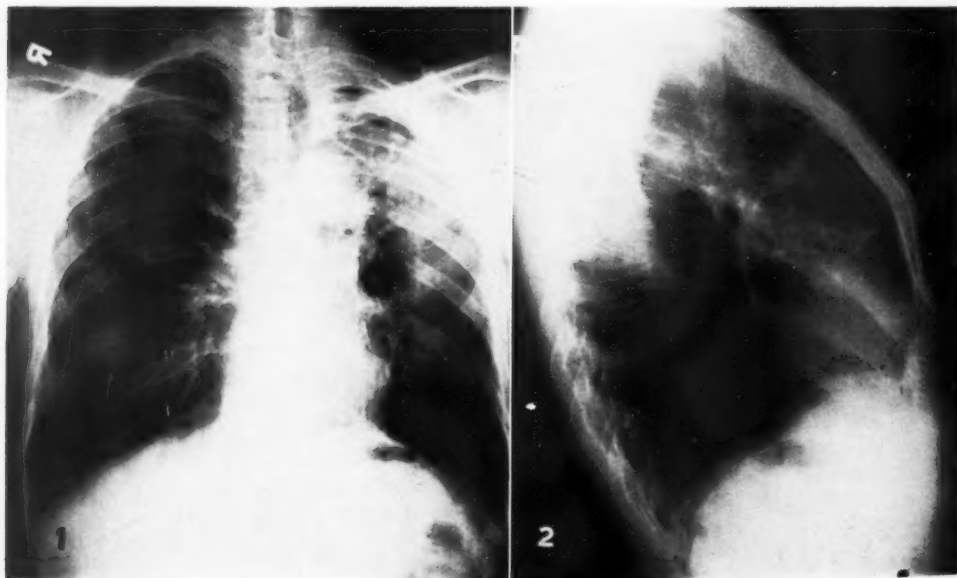


Fig. 1. Postero-anterior film disclosing left mid and upper lung field disease.

Fig. 2. Lateral chest film with disease obviously in the left upper lobe and questionable disease in the superior segment of the left lower lobe.

¹ From the Departments of Radiology, Chicago State Tuberculosis Sanitarium; College of Medicine, University of Illinois; Grant Hospital, Chicago, Ill. Presented, as part of a Symposium on Current Management of Pulmonary Tuberculosis, at the Forty-third Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 17-22, 1957.

tically eliminating an apparent change due to technic. The conventional film (lower kilovoltage range) was eliminated since it was felt that the higher-kilovoltage film was superior.

LAMINAGRAPHY

Laminagraphy has been an important aspect of our studies. The examination was performed with the patient recumbent, as our equipment does not permit erect laminagraphy. Both anteroposterior and lateral laminagraphs of the chest were utilized.

A total of 904 anteroposterior laminagraphs were obtained. These were most helpful in studying extent and severity of disease. Cavities not visualized in usual plain films are very definitely demonstrated on the anteroposterior laminagraphs. Lateral laminagraphs numbered 362. These were useful in delineating the disease as to extent and location. Some investigators have called this "bloodless thoracotomy." A frequent enigma facing the radiologist and surgeon is the exclusion or inclusion of disease in the superior segment, for instance, of the lower lobe when the upper lobe is severely involved. Figures 1-3 are illustrative of this problem and its solution.

BRONCHOGRAPHY

Four hundred and sixteen bronchograms have been obtained at the Chicago State Tuberculosis Sanitarium. The advantages of the new opaque media used for this purpose have been utilized. The importance of bronchography cannot be stressed too greatly, as pulmonary mapping for the surgeon is thus accomplished with ease. At our institution, we have been using Dionosil Oily, which apparently disappears from the lungs in four to five days. Since the medium disappears rapidly, infiltrative lesions due to tuberculosis are not obscured and future progress studies are not hindered. We have had no experience in using other quickly disappearing drugs, as Visciodol, Dionosil Aqueous, etc.

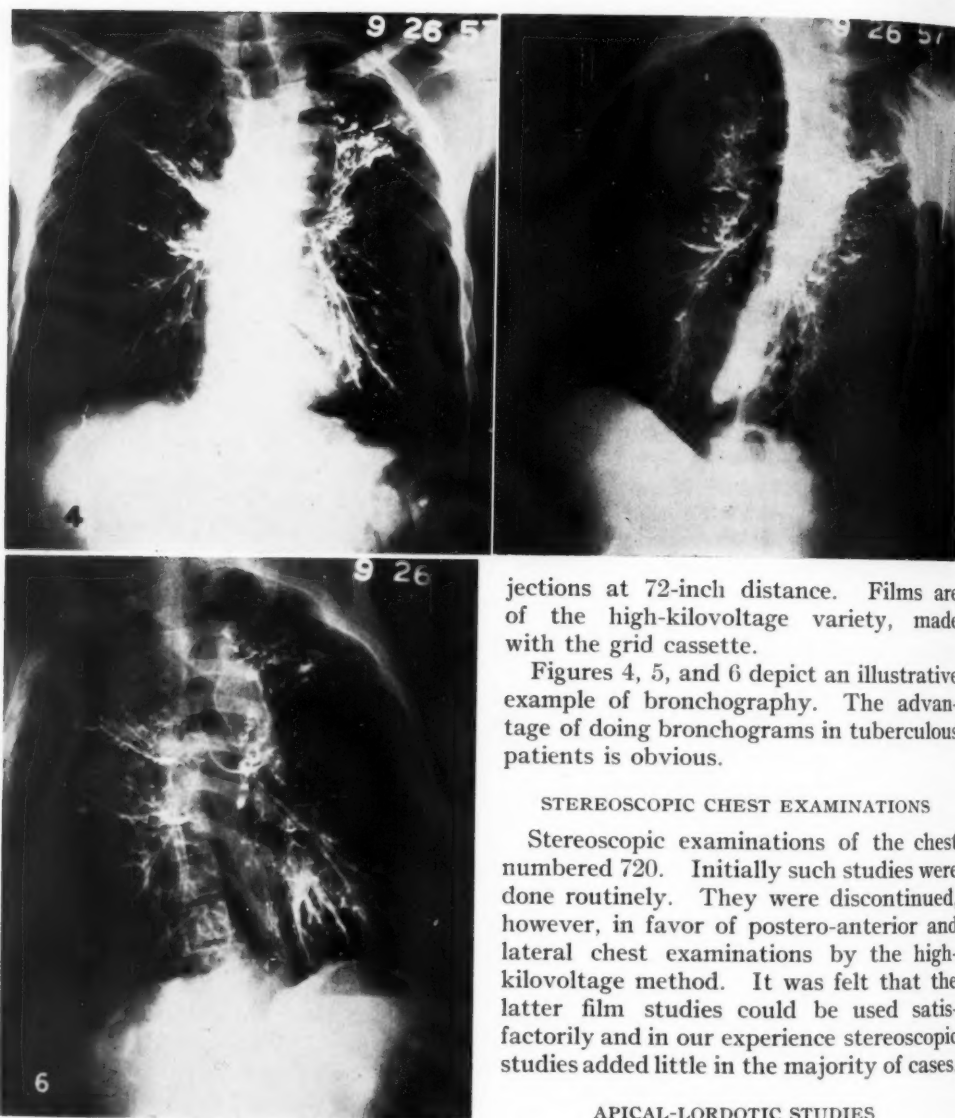
The method for doing bronchography is



Fig. 3. Lateral laminagraph disclosing disease in the lower lobe. This is of inestimable aid to the operating surgeon for definitive surgery. The superior segment of the left lower lobe is definitely identified because one sees the left oblique fissure and/or the superior segment bronchus (retouched for better definition in this reproduction).

that originated by Gianturco (2). The procedure is simple and can be done rapidly, so that many patients may be examined if a team for doing bronchography can be built up. At our institution as many as 15 examinations have been done during one "bronchographic morning." The surgeon anesthetizes the pharynx and tracheobronchial tree. A topical anesthetic such as Pontocaine or cocaine is used. When good anesthesia is assured, the surgeon passes a tube either through the nose or through the mouth into the trachea and secures it in place at the skin. Under fluoroscopic guidance, the endotracheal tube is so placed that its distal end lies immediately above the carina of the trachea.

Altogether 40 c.c. of Dionosil Oily is used. With the patient in a recumbent position on his left side, with the head elevated about 15°, 20 to 25 c.c. of the medium is injected into the tracheobronchial tree and this gravitates into the left lung. The patient is then turned onto his



Figs. 4-6. A bronchographic study.

opposite side (right side down and left side up), the head is again elevated 15°, and 15 to 20 c.c. of the Dionosil is rapidly injected. The tube is then removed and the patient is placed in a supine horizontal position without head elevation for ten to fifteen seconds. Following this, erect films are taken of the thorax in the postero-anterior and both oblique pro-

jections at 72-inch distance. Films are of the high-kilovoltage variety, made with the grid cassette.

Figures 4, 5, and 6 depict an illustrative example of bronchography. The advantage of doing bronchograms in tuberculous patients is obvious.

STEREOSCOPIC CHEST EXAMINATIONS

Stereoscopic examinations of the chest numbered 720. Initially such studies were done routinely. They were discontinued, however, in favor of postero-anterior and lateral chest examinations by the high-kilovoltage method. It was felt that the latter film studies could be used satisfactorily and in our experience stereoscopic studies added little in the majority of cases.

APICAL-LORDOTIC STUDIES

Only 20 apical-lordotic studies of the chest were performed. These are frequently useful, but in our institution the need for them was cut to a bare minimum, since it was felt that the high-kilovoltage studies, along with laminagrams, were much more accurate.

CONCLUSIONS

Methods for examining the tuberculous patient have been presented.

High-kilovoltage routine film examinations are done. Anteroposterior and lateral laminagraphy, bronchography, and occasionally stereoscopic studies are most helpful for localizing disease, including or excluding the presence of cavitation and delineating the extent of the process. Apical-lordotic films are done infrequently.

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55 E. Washington St.
Chicago 2, Ill.

SUMMARIO IN INTERLINGUA

Examine Radiographic Del Thorace In Le Patiente Tuberculosic

Es describe le methodos roentgeno-graphic del examine thoracic usate al Sanatorio Statal pro Tuberculose a Chicago. Le procedimento de base, a que omne patiente es submittite routinarimente al tempore de su admission, consiste de un examine thoracic postero-anterior e lateral, con un studio del progresso effectuate inter quatro e sex septimanas plus tarde. Technicas a alte kilovoltage es usate (125 kv).

Laminagraphia antero-posterior e lateral, bronchographia, e in certe casos studios stereoscopic es utile pro localisar le foco del morbo, pro includer o excluder le presentia de cavitation, e pro delinear le extension del processo. Expositiones apico-lordotic es obtenite a vices, sed lor uso ha essite reducite a un minimo a causa del excellento resultatos de laminagraphia e radiographia a alte voltage.



Medical Management of Pulmonary Tuberculosis¹

KARL H. PFUETZE, M.D., and MARJORIE M. PYLE, M.D.

DURING THE past few years chemotherapy has become the cornerstone in the treatment of all forms of active tuberculosis. This is certainly true of pulmonary tuberculosis. Since streptomycin came into general use ten years ago as an effective antituberculosis agent, several other drugs have proved to be valuable additions to the armamentarium.

The following basic principles (1) in the treatment of pulmonary tuberculosis have now become generally accepted in the United States.

1. All patients with active pulmonary tuberculosis or any of its complications should receive chemotherapy. This definitely includes tuberculous pleurisy with effusion, which, when inadequately treated, results in some form of active tuberculosis within five years in 25 to 62 per cent of the cases (2, 3).

2. The drug regimen should include at least two drugs given concurrently.

3. Chemotherapy should be uninterrupted and prolonged—for at least one year and often for two or more years, depending on the amount and type of residual disease present. In some cases chemotherapy should probably be given indefinitely.

Though these principles are widely accepted among tuberculosis physicians, they seem to require renewed emphasis from time to time for the benefit of the physician who treats tuberculosis only occasionally.

It is not the intent of this paper to present a review of all the various regimens which have been reported as effective by the many investigators in this field. Rather, it is our hope to deal with presently accepted general principles involved in the treatment of pulmonary tuberculosis, the regimens most commonly used, and the results which may be expected depending

upon the amount, type, and distribution of the disease processes.

MAJOR ANTIMICROBIAL AGENTS

The three major antimicrobial agents used today in treatment of tuberculosis are isoniazid, streptomycin (and its hydrogenated derivative, dihydrostreptomycin), and para-aminosalicylic acid.

Isoniazid, first introduced in 1952 (4, 5), has proved to be probably the most effective—and cheapest—of the antituberculosis agents. It is strikingly effective in reducing cough, expectoration, fever, and malaise, and in improving the weight and general well-being of the patient. With the usual dosage of 3.0 to 5.0 mg. per kilogram of body weight, toxic side-reactions seldom occur. These consist chiefly of peripheral neuritis, hyperreflexia, and positional hypotension. The latter two, when they do occur, are rarely serious. They often subside or disappear without discontinuance of the drug. When peripheral neuritis occurs, the dosage should be lowered or the medication interrupted until symptoms subside. The addition of pyridoxine (vitamin B₆) in doses of 25 to 100 mg. t.i.d. is quite helpful in the management of such cases. Like streptomycin, isoniazid, when used alone, results in the emergence of drug-resistant organisms after a few months, and for this reason the concomitant administration of another antituberculosis agent is recommended whenever possible. Though the occurrence of isoniazid-resistant organisms does not have the same clinical significance that streptomycin resistance implies, progression of disease is frequently observed in patients whose organisms become resistant to isoniazid.

Streptomycin was the first antimicrobial agent of clinical importance in the

¹ From the Chicago State Tuberculosis Sanitarium, Chicago, Ill. Presented, as part of a Symposium on Current Management of Pulmonary Tuberculosis, at the Forty-third Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 17-22, 1957.

treatment of tuberculosis (6) and ushered in the era of chemotherapy for this disease. A potent and effective drug, its usefulness was limited to a considerable extent by the emergence of streptomycin-resistant tubercle bacilli after a few months of treatment. The chief toxic manifestations are vestibular damage and allergic reactions. Formerly, when dosages of 1 to 2 gm. daily were employed for prolonged periods, vestibular disturbance occurred rather frequently. With doses of 1 gm. twice weekly, this hazard is practically eliminated. When an allergic reaction occurs, the patient may often be desensitized by gradually increased daily dosages, starting with 0.05 to 0.1 gm. streptomycin or dihydrostreptomycin.

Dihydrostreptomycin, a hydrogenated derivative of streptomycin, has the same therapeutic efficacy. It is less likely to cause allergic reactions and may be used as a substitute in patients who are hypersensitive to streptomycin. Unlike the latter drug, it causes little or no vestibular damage; but it has the distinct disadvantage, when given daily in doses of 1 to 2 gm. for prolonged periods, of causing deafness in some patients. This deafness may be partial or total and is irreversible. With the presently recommended dosage of 1 gm. twice weekly, appreciable deafness seldom occurs. To avoid the possibility of either vestibular damage from streptomycin or deafness from dihydrostreptomycin, many physicians prescribe a combined preparation of 0.5 gm. streptomycin and 0.5 gm. dihydrostreptomycin twice weekly.

Para-aminosalicylic acid (PAS), though less effective than isoniazid or streptomycin, has an important place in the chemotherapy of tuberculosis because of the considerable delay in the emergence of isoniazid- or streptomycin-resistant organisms which results when PAS is used in combination with either or both of these drugs. It is now most commonly used in the form of its sodium or potassium salt. The dosage of PAS most often prescribed is 12 gm. daily, divided into three or four

doses. The toxic side-reactions most often encountered are gastrointestinal disturbances such as diarrhea, nausea, and abdominal distress. Such allergic manifestations as occur usually involve the skin. In rare cases liver damage (7) may be severe enough to cause jaundice. PAS has also been reported to cause a clinical picture quite similar to that of acute infectious mononucleosis (Lichtenstein *et al*). The drug should be discontinued when hepatitis or severe allergic reactions occur.

OTHER USEFUL DRUGS

Other useful antimicrobial agents for tuberculosis are viomycin, pyrazinamide, and cycloserine. Though less effective and used much less often than the three "major" drugs, these can sometimes be employed to good advantage in patients whose strains of tubercle bacilli are resistant to streptomycin and isoniazid.

Viomycin is administered by intramuscular injection. It is less effective than streptomycin, and its value is limited because of its potential toxicity. However, toxic side-reactions, such as disturbance of electrolyte balance and injury to kidneys and liver, are uncommon with dosages of 1 to 2 gm. twice weekly. As with the other antimicrobial agents, organisms resistant to viomycin emerge after prolonged use. For this reason it should be given in combination with another agent. We have found it to be most useful in association with pyrazinamide shortly before and for several weeks after resectional surgery, for prevention of postoperative spread of the disease in patients whose organisms are resistant to isoniazid and streptomycin.

Pyrazinamide (PZA) is a synthetic agent which has been reported to have a potent but short-term effect in clinical tuberculosis when used alone (8). In early studies on this drug, it was found that clinical evidence of drug resistance occurred rapidly, usually in six to eight weeks. Another factor which limits its usefulness is the potentially toxic effect on the liver. In the VA report of 1956 (9), approximately 15 per cent of the patients receiving py-

razinamide were said to show evidence of hepatotoxicity, and about 1 per cent showed frank jaundice. Fortunately, the liver damage is reversible in most instances when the drug is stopped. For this reason, liver function studies are imperative at frequent intervals on patients receiving PZA, and its use is not recommended outside the hospital.

We have not used PZA in the primary treatment of our patients, but it has a useful place when given in combination with viomycin for a week or two before and for two or more months after surgical resection in patients whose organisms are resistant to streptomycin and isoniazid. In fact, this regimen has been employed almost routinely in such patients in our hospital, with very favorable results (10). This same combination of PZA and viomycin, however, when used in the retreatment of patients with old, chronic cavitary disease, with positive sputum and drug-resistant organisms has proved to be most disappointing (10). The daily dosage of PZA which we have employed is 25 to 30 mg. per kilogram of body weight, given in three doses, with a maximum total dose of 3.0 gm. daily.

Cycloserine (Seromycin) is an antibiotic derived from *Streptomyces orchidaceus*. It is still in the investigational stage and is not yet available for general use. Used alone as primary treatment, it leaves much to be desired for, as with the other drugs, resistance occurs. It also has undesirable side-effects on the central nervous system. Tremors, hyperreflexia, clonic convulsions, and even psychotic reactions have been reported (11). We have noted these reactions, too, in our use of the drug. At this writing it does not appear likely that cycloserine will prove of major importance in the primary treatment of pulmonary tuberculosis. However, it does have potent antimicrobial properties in tuberculosis and, if the undesirable side-effects can be more adequately controlled, it may find an important place in the management of retreatment cases in which the patients' organisms are resistant to all of the other

antimicrobial agents. Because of the serious toxic side-reactions which may occur, cycloserine should be used only in the hospital.

GENERAL PRINCIPLES OF CHEMOTHERAPY

Each of the antimicrobial agents used in the treatment of tuberculosis may cause drug-resistant organisms to emerge. Since resistant organisms are the chief obstacle to successful treatment, the clinician must bend every effort to prevent or delay as long as possible their appearance. This is best done by giving two or more drugs concurrently, for there is no cross resistance between any of the drugs mentioned above. The longer the delay in the appearance of drug-resistant organisms, the more effective the chemotherapy is apt to be.

Chemotherapy Regimens: Though there is as yet no generally accepted "optimum" chemotherapy regimen, the following (1) are the most commonly used: (a) isoniazid, 100 mg. t.i.d. plus streptomycin, 1.0 gm. twice weekly; (b) isoniazid 100 mg. t.i.d. plus PAS, 12 gm. daily divided into three or four doses; (c) isoniazid, 100 mg. t.i.d. plus streptomycin, 1.0 gm. twice weekly, plus PAS, 12 gm. daily in three or four doses. We prefer the last mentioned regimen for all of our patients who have not received chemotherapy previously for their tuberculosis. Although it would be difficult to prove statistically that it is the best of the three, we are well satisfied with the results when triple therapy is used and can recall no case in which we regret using all three drugs simultaneously. The great majority of the patients admitted to our hospital have extensive disease, and many are acutely ill when admitted, making intensive chemotherapy mandatory.

Effectiveness and Limitations of Chemotherapy: Chemotherapy is definitive treatment in the vast majority of cases (12) in which the disease process is exudative or pneumonic in character with a minimum of irreversible tissue destruction. Lesions of recent origin, including many with cavitation, may be expected to heal completely on chemotherapy with little or no

residual scar tissue. The older the process and the greater the component of caseation and cavity formation, the less is the likelihood that chemotherapy alone will result in satisfactory healing. Many patients with pulmonary tuberculosis, of course, present a mixture of varying degrees of exudation, fibrosis, and caseous necrosis. In these cases the extent of healing with chemotherapy is often considerable but still leaves residuals of caseous foci which are potentially dangerous as the source of a future reactivation.

Chemotherapy is far more effective in previously untreated patients than in those who have formerly received antimicrobial agents (13). This confirms and emphasizes the need for long-term *continuous* chemotherapy in patients being treated for the first time, until the disease process is brought definitely under control. The vast majority of our chemotherapy failures occur among patients who had previously interrupted their treatment by leaving the hospital one or more times against medical advice. In general, the more frequently chemotherapy has been interrupted in the past, the poorer the prognosis and the greater the chance that drug-resistant organisms will emerge.

In retreatment cases the sensitivity of the organisms must be determined if the clinician is to select a suitable chemotherapy regimen for the patient. Hence the importance of adequate bacteriological studies is readily apparent.

OTHER MODES OF TREATMENT

Rest is still important in the treatment of pulmonary tuberculosis, particularly during the early active stage of the disease. Prior to the advent of chemotherapy, strict bed rest for long periods of time was the order of the day. However, during the past several years this has been limited to the critically ill patients. In our sanitarium the patient is permitted limited exercise, such as bathroom privileges, as soon as his fever has subsided and other signs of toxicity have disappeared. This usually occurs in two to three weeks.

With chemotherapy, physical activities can be safely increased much more rapidly than in the past and the period of hospitalization greatly reduced (14).

Pneumotherapy, which enjoyed a tremendous vogue until about 1950, has declined steadily since combined chemotherapy and resective surgery came into general use. Artificial pneumothorax is rarely used now. Since our hospital opened four years ago, no pneumothorax has been induced for therapeutic purposes. Pneumoperitoneum as a form of collapse therapy has likewise lost much of its popularity in the past several years, and the number of its adherents continues to decline.

HOSPITAL VS. HOME TREATMENT

Home treatment can be recommended for a small proportion of patients, but these should be carefully selected. Due regard must be given to such factors as the extent and type of disease, the status of the patient's sputum, the opportunity for adequate nursing care, the availability of frequent bacteriological and radiological studies, the intelligent cooperation of the patient and his family, and the ability and experience of the physician in charge of the case. In the great majority of cases, the facilities and trained personnel of the tuberculosis hospital provide the best means for a rapid and permanent recovery.

COMMENT

Many factors influence the outcome of pulmonary tuberculosis. Chief among these are the character and extent of the disease at the time treatment is started, the pulmonary reserve, the patient's native resistance, which can be evaluated only with the lapse of time, and (perhaps most important of all) his willingness to cooperate fully with his physician in the management of his case. In minimal cases the prospect for recovery is uniformly good. With moderately advanced disease, particularly unilateral, the vast majority of patients will recover with proper treatment. In the far advanced

groups the prognosis becomes more guarded, but even here the percentage of recoveries can be surprisingly good, especially in previously untreated cases.

It should be emphasized that the skill and sympathetic understanding with which the physician manages the patient have a great influence on the ultimate outcome of any case of tuberculosis. The patient must be impressed with the fact that, despite the "wonder drugs" and the marvels of present-day chest surgery, tuberculosis is still a dangerous and unpredictable disease requiring skillful long-term management on the part of the physician and full cooperation on the part of the patient.

1919 West Taylor St.
Chicago 12, Ill.

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SUMMARY IN INTERLINGUA

Tractamento Medical De Tuberculose Pulmonar

Le chimotherapia es le petra angular del tractamento de omne formas de tuberculose pulmonar. Le tres major drogas antimicrobial que es usate al tempore presente es isoniazido, streptomycina, e acido para-aminosalicylic (PAS). Cata un de iste tres drogas resulta, in le curso del tempore, in le emergentia de organismos que es resistente a su action, e ecce le ration pro que le administration combinate de plus que un droga es recommendate quandocunque possibile. Le autores ha trovate le uso combinate de isoniazido, streptomycina, e PAS un procedimento multo satisfacente.

Chimotherapia es le plus efficace in patientes non previeamente tractate. On pote expectar que morbo de origine recente, frequentemente in le presentia de cavitation, es resanate completamente, con pauc o nulle residue histos cicatricial. Quanto plus ancian le processo e quanto plus considerable le componente de caseation e de formation cavitari, tanto plus basse le probabilitate que agentes chimotherapeutice sol va producer resultados satisfactori.

Altere drogas de uso corrente es mentionate—viomycina, pyrazinamido, e cycloserina—e le avantages del hospitalisation pro le majoritate del patientes es signalate.

The Surgery of Pulmonary Tuberculosis

HIRAM T. LANGSTON, M.D.

UNDER CURRENT concepts of management, pulmonary tuberculosis is treated by antibiotics and chemotherapeutic agents. Surgery is called upon to handle residuals of lung destruction that cannot or do not respond to these agents, threatening the patient's ultimate security thereby.

TIMING OF SURGICAL INTERVENTION

It would seem ideal to observe the course of pulmonary tuberculosis under chemotherapy and resort to surgical intervention only at a time when it could be demonstrated unequivocally that medical management would be inadequate. Because of the fact, however, that the commonly used drugs provoke resistance on the part of the tubercle bacillus, and because of the poor results attendant upon *resective* surgery except when carried out under protection of chemotherapy, this expectant attitude is not advised. Thus it is, that, when the disease has been brought under control by chemotherapy so that surgical intervention can be safely carried out, an evaluation of the anatomical residuals is in order to demonstrate or predict the necessity for surgery.

In general terms, the disease can be considered to be under control when the process shows radiologic stability and the sputum is negative for tubercle bacilli under ordinary means of examination. The ideal time, therefore, for surgical intervention is that moment when this form of treatment can be seen to be necessary and when chemotherapeutic control is achieved.

THE ANATOMICAL RESIDUALS

Demonstrable residuals may take several forms. The open cavity is the most obvious surgical target. Whether or not

such cavities can actually heal while remaining clearly open is vigorously debated. Until proof of such occurrence is more certain and our ability to recognize this phenomenon more definite, open cavities remain as obvious indications for surgical intervention. Cavities that are filled, or for that matter areas of focal necrosis that remain and are of reasonable size (1.0 to 1.5 cm.) may well be surgical targets. This is particularly true if such lesions tend to conglomerate and present a more impressive volume in their aggregate than they do singly.

Bronchiectasis is another frequently encountered lesion following a usually rather severe tuberculous process. Its importance may be debated, but it had best be considered the sequel of widespread lung disease. It can be regarded as the anatomical expression of lung that has been ravaged by tuberculosis. The changes are irreversible, are not amenable to collapse measures, and form, we believe, a point of insecurity tending to make recurrence or exacerbation likely when chemotherapeutic control is eventually lost.

Carnification due to organization of pneumonic exudates with shrinkage and its counterpart—compensating emphysema—all occur in varying admixtures, independent of any consideration of direct bronchial disease. These manifestations are likewise an indication of the severe process.

CHOICE OF OPERATION

The current philosophy has swung completely to resection of the areas of involved lung and definitely away from collapse measures. The availability and effectiveness of the chemotherapeutic agents brought this about. Resection of a tuberculous lung or portions thereof could not be performed with any reasonable

¹ From the Chicago State Tuberculosis Sanitarium and the University of Illinois College of Medicine. Presented, as part of a Symposium on Current Management of Pulmonary Tuberculosis, at the Forty-third Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 17-22, 1957.

degree of success prior to the advent of chemotherapy except in cases of quiescent disease and this only occasionally. Collapse, on the other hand, could be carried out without such protection and was eminently successful. It is obvious that the clean excision of the anatomical residuals of tuberculous disease is a far better approach to management than the "entombment" of these residuals by collapse, such as thoracoplasty.

Since excision cannot always be carried out, and for a variety of reasons, a choice of procedures is to be considered. The indication is for resection except when the anticipated amount of lung tissue requiring removal exceeds that which the candidate's cardiorespiratory reserve will permit without crippling, or when, because of inadequate control of the tuberculous disease by chemotherapy (bacterial resistance to all agents), the safety of the procedure is doubtful. Under these circumstances, some form of collapse is in order. Patent cavernous disease without significant associated bronchiectasis, located above the fifth rib posteriorly, offers the best prognosis under collapse. Nodular disease, bronchiectasis, and carnified lung are relatively unaffected by collapse.

Collapse in the present era means a thoracoplasty. This must take the form either of a standard seven-rib posterolateral extrapleural resection of the Alexander type, usually performed in stages, or a one-stage extrapariosteal separation of a selected area of lung with filling by prosthesis. These prostheses are foreign bodies and have the detractions generally attributable to the latter. Paraffin, Lucite spheres, and Ivalon are popular materials utilized for this purpose.

The smallest amount of lung which will cleanly extirpate the disease should be resected. Segmental resection is safe and satisfactory but, under conditions of meager or poor chemotherapeutic control, wider resections to the extent of lobectomy or pneumonectomy are less apt to lead to complications of a tuberculous nature,

since they are far more likely to be effected through cleaner planes.

Combinations of resection and thoracoplasty are practicable. When a resection, to be satisfactory in extirpating the disease, leaves behind a piece of lung too small to fill the hemithorax readily, some form of tailoring procedure is necessary. This is done at the time of the resection or better still (in our opinion) before the resection, since the concomitant procedure increases morbidity. We contend that an adequate anatomical evaluation preoperatively will permit identification of those portions of lung that will, or probably will, require resection. We do a tailoring procedure before the definitive operation when our estimate suggests a resection which volumetrically exceeds a lobe. This practice has often forestalled a complication that could be expected to follow incomplete or markedly delayed re-expansion of lung, as well as the increased morbidity attendant upon the combined procedure.

RESULTS

At the Chicago State Tuberculosis Sanitarium, between January 1954 and July 1957, we have carried out some 423 operations for pulmonary tuberculosis. This has been done with a mortality rate of 3.7 per cent for pneumonectomies and 1.7 per cent for lobectomies. Our morbidity in terms of surgical complications can be expressed as 5.2 per cent. Relapses have occurred infrequently, in approximately 3 per cent of the surgical patients treated. It must be remembered that many of these had far advanced disease initially and their longevity with freedom from tuberculosis is short even from the outset. It must also be pointed out that even the relapses may be successfully retreated on occasion.

1919 West Taylor St.
Chicago 12, Ill.

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SUMMARIO IN INTERLINGUA

Chirurgia In Tuberculose Pulmonar

In tuberculose pulmonar, le function del chirurgia es eliminar residuos de destruction pulmonar que non responde a agentes antibiotic e chimotherapeutic e assi menacia le securitate del patiente a longe vista. Le tempore ideal pro le operation es post que le morbo es chimotherapeuticamente subjugate, un stato evidentiante per sputo negative e stabilitate radiologic.

Indicationes pro therapia chirurgic include cavitates aperte, cavitates plenate o areas de necrose focal de dimensiones plus o minus considerabile, bronchiectasis, e carnification.

Currentemente le tendentia es rejicer therapia a colapso in favor de resection

del afficite areas pulmonar. Resection es indicate, excepte in casos ubi le quantitate de histo que debe esser eliminate excede le limite que le reserva cardiorespiratori pote tolerar sin risco de infirmitate o ubi, a causa de un inadequate subjugation chimotherapeutic del morbo, le inoffensivitate del procedimento non es foras de dubita. Sub tal conditiones, colapso (i.e., thoracoplastia) es possibilmente utile.

Ab un serie de 423 operationes pro tuberculose pulmonar, le autores reporta un mortalitate de 3,7 pro cento pro pneumonectomias e de 1,7 pro cento pro lobectomias. Recidivas occurreva in circa 3 pro cento del casos operate.



Roentgen Evaluation of the Chest After Thoracic Surgery¹

MYRON MELAMED, M.D.

WITHIN THE PAST few years there has been a remarkable increase in the number of surgical procedures involving the thorax. Accordingly, there has been an accompanying rise in the number of radiographic examinations in the postoperative period. The frequency of x-ray studies in this stage of the patient's care serves as an excellent indication of their usefulness in detecting complications.

While many papers have been written on various specific phases of the evaluation of the postoperative chest radiograph, relatively little has been published on the overall roentgen picture of the chest after thoracic surgery. Johnstone (2), Allison (1), and Linder (4) do, however, discuss some general concepts of surgical procedure in relationship to the postoperative radiograph.

We have summarized our experience in approximately 300 selected cases in which surgical procedures were performed, principally for pulmonary tuberculosis (3). Because of the nature of the problems encountered, the operations performed were mainly segmental resection, lobectomy, pneumonectomy, and space-diminishing procedures.

Normals are frequently hard to define in the postsurgical period because of the presence of traumatic change in all anatomic layers of the thorax. Pulmonary or mediastinal changes may be masked by overlying soft-tissue edema, by hematoma, or by air collections. Complications may similarly be difficult to evaluate correctly.

A classification is presented which outlines changes in the various structures of the thorax, as follows:

- I. *Soft Tissues*—Extracostal
 - A. Hematoma and edema
 - B. Air collections
 - 1. Incision
 - 2. Muscle
 - 3. Subcutaneous and fascial plane
 - 4. Air along neurovascular bundles
 - C. Subscapular space air-fluid collections
- II. *Foreign Bodies*
 - A. Drainage tubes
 - B. Dressings
 - C. Pressure dressings
 - D. Tape
- III. *Ribs*
 - A. Resection
 - B. Regeneration
- IV. *Diaphragm*
 - A. Elevation
 - B. Adhesions
- V. *Mediastinum*
 - A. Displacement
 - 1. To surgical side
 - 2. Away from surgical side
 - B. Fluid
 - 1. Increased "hilus" shadow
 - 2. Mediastinal exudate
 - C. Emphysema
- VI. *Pleural Cavity*
 - A. Air fluid collection
 - 1. General in pleural cavity
 - 2. Primarily apical
 - 3. Primarily anterior
 - 4. Loculated
 - 5. Basal
 - B. Hematoma or unusual exudate
 - C. Volume changes
- VII. *Lungs*
 - A. Rearrangement
 - 1. Fissures demonstrated, postero-anterior and lateral views
 - 2. Accessory fissures
 - B. Bronchus stump
 - C. Compensatory emphysema
 - D. Herniation of lung
 - E. Hematoma
- VIII. *Complications*
 - A. Excess air in soft tissues
 - B. Pneumothorax
 - C. Chronic pneumothorax or subscapular air

¹ From the Departments of Radiology, Chicago State Tuberculosis Sanitarium, Research and Educational Hospitals, University of Illinois, and Grant Hospital, Chicago, Ill. Presented, as part of a Symposium on Current Management of Pulmonary Tuberculosis, at the Forty-third Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 17-22, 1957.

- D. Mediastinal emphysema
- E. Bleeding into soft tissues or pleural cavity
- F. Mediastinal displacement
- G. Infection of surgical wound and/or empyema
- H. Bronchopleural fistula
- I. Infection about prosthesis
- J. Atelectasis
- K. Pneumonia

55 E. Washington St.
Chicago 2, Ill.

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SUMMARIO IN INTERLINGUA

Evaluation Roentgenographic Del Thorace Post Chirurgia Thoracic

Le alterationes demonstrabile per medios roentgenologic post operationes pro tuberculose pulmonar—resection segmental, lobectomia, pneumonectomy, e manovras a reduction de spatio—es classificate sub le sequente titulos principal: Histo molle extracostal, corpores alien, costas, diaphragma, mediastino, cavitate pleural, pulmones, e complicationes. Le ultime

titulo, i.e., complicationes, comprende excessu de aere in le histos molle, pneumothorace, pneumothorace chronic o aere subscapular, emphysema mediastinal, sanguination a in le histos molle o le cavitate pleural, displaciamento mediastinal, infection de vulnere chirurgic e/o empyema, fistula bronchopleural, infection circa un prosthese, atelectasis, e pneumonia.



The Lateral Roentgenogram of the Neck

(With Comments on the Atlanto-Odontoid-Basion Relationship)¹

MARK H. WHOLEY, M.D., ANDRÉ J. BRUWER, M.B., Ch.B., and HILLIER L. BAKER, Jr., M.D.

THE LATERAL cervical roentgenogram is a useful guide in evaluating the bony and soft-tissue relationships of the neck. In an effort to establish certain normal measurements in this area we reviewed 700 lateral cervical roentgenograms from the files of the Mayo Clinic, of which 600, technically adequate and without detectable abnormalities, were included in the study. The roentgenograms were taken with the patient sitting erect and with the neck in the neutral position. The target-to-film distance was 60 inches. Measurements were made from the films without correction for the minor error due to magnification.

REGIONS EVALUATED

Retropharyngeal Space: In Figure 1 the retropharyngeal space is indicated by the letter A. For convenience, we chose to measure this from the antero-inferior aspect of the second cervical vertebra to the posterior wall of the pharynx.

Retrotracheal Space: The retrotracheal space, represented in Figure 1 by the letter B, was measured from the antero-inferior aspect of the sixth cervical vertebra to the posterior aspect of the trachea. Although involvement of the retropharyngeal

space by disease is well documented, involvement of the adjacent retrotracheal space is seldom described.

Spinal Canal: Anteroposterior Diameter: Measurements on the spinal canal were made from the posterior aspect of the vertebrae to the nearest point on the corticated line at the fusion of the laminae and spinous processes of cervical vertebrae one, two, three, five, and seven. This region is indicated in Figure 1 by the letters C, D, E, F, and G.

The Atlanto-Odontoid-Basion Relationship: The relationships of the tip of the odontoid process to the basion (anterior lip of the foramen magnum) and to the anterior arch of the atlas were studied.

Esophageal Air: The presence or absence of air in the cervical portion of the esophagus was noted.

THE RETROPHARYNGEAL AND RETROTRACHEAL SPACES

The normal values and variations for sagittal measurements of the retropharyngeal and retrotracheal spaces are listed in Table I. It is suggested that measurements for the retropharyngeal space greater than 7 mm. in both children and adults, and measurements of the retrotracheal space

TABLE I: NORMAL SAGITTAL MEASUREMENTS

Region Evaluated	Normal Sagittal Measurements for Children 15 Years and Under (120 cases)		Normal Sagittal Measurements for Adults (480 cases)	
	Average (mm.)	Range (mm.)	Average (mm.)	Range (mm.)
Retropharyngeal space	3.5	2-7	3.4	1-7
Retrotracheal space	7.9	5-14	14.0	9-22
Cervical spinal canal:				
At first cervical vertebra	21.9	18-27	21.4	16-30
At second cervical vertebra	20.9	18-25	19.2	16-28
At third cervical vertebra	17.4	14-21	19.1	14-25
At fifth cervical vertebra	16.5	14-21	18.5	14-25
At seventh cervical vertebra	16.0	15-20	17.5	13-24

¹ From the Mayo Clinic and Mayo Foundation, Rochester, Minn. (M. H. W., Fellow in Radiology, Mayo Foundation; A. J. B. and H. L. B., Section of Roentgenology, Mayo Clinic and Mayo Foundation). The Mayo Foundation is a part of the Graduate School of the University of Minnesota. Accepted for publication in February 1958.

greater than 14 mm. in children and 22 mm. in adults, should warrant further investigation to exclude the possibility of a pathologic process.²

With reference to the retrotracheal space, we have noted that the contour of the posterior tracheal wall is not influenced by cervical hypertrophic ridging as may often be observed to occur in the barium-filled esophagus. Any localized irregularity of the posterior tracheal wall should be regarded as significant until proved otherwise. Such localized bulges may be due to benign or malignant neoplasms (primary or secondary), to hematomas, or to inflammation (Fig. 2, *a, b, c*).

An incidental feature noted during this study was the presence of a bolus of air in the cervical portion of the esophagus in many asymptomatic patients. This finding, once thought to be peculiar to achalasia (1), has recently been noted in cases of corrosive stricture (2) and malignant occlusion of the esophagus (3). Its occurrence probably is not significant in the majority of instances.

SPINAL CANAL

Measurements of the cervical part of the spinal canal range from about 22 mm. at the first cervical vertebra to about 18 mm. at the seventh. It was of interest that the range for children (most of whom were between three and six years of age) was almost identical with the range for adults. This seems to indicate that the sagittal diameter of the spinal canal is established early in life and that the major changes occurring after childhood are in the growth of the bones comprising the canal.

We agree with Wolf and his associates (4) that the sagittal measurements may be significantly reduced by hypertrophic ridging, but that without further studies it is

² The range between the latter two measurements is somewhat artificial in our series, in that most of the children were in the first few years of life. It would be more accurate in teen-agers to take into account body build, as some of them will no doubt fall into the adult range. At any rate, the maximal measurement of 22 mm. in adults and well developed adolescents should arouse suspicion of the presence of pathological condition.



Fig. 1. Normal lateral view of the neck indicating the regions evaluated in this study. A. Retropharyngeal space, second cervical vertebra. B. Retrotracheal space, sixth cervical vertebra. C to G. Cervical spinal canal. C. First cervical vertebra. D. Second cervical vertebra. E. Third cervical vertebra. F. Fifth cervical vertebra. G. Seventh cervical vertebra.

not possible to evaluate the canal accurately in such cases, since the roentgen measurements do not necessarily reflect the true dimensions. What appears to be a hypertrophic lip extending posteriorly into the canal on the lateral roentgenogram may in fact be located far laterally at Luschka's intervertebral joints. Consequently, unless there is adequate proof on the anteroposterior view or on sagittal tomograms that the hypertrophic ridging extends across the width of the cervical interspace, a

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decreased sagittal measurement may be misleading. On the other hand, increase of the sagittal diameter above the normal

Fig. 2, *a*. Lateral view of the neck indicating diffuse widening of the retropharyngeal and retrotracheal spaces as a result of abscess formation secondary to esophageal perforation. Note evidence also of interstitial emphysema.

b. Same view as in *a* indicating localized widening of the retrotracheal space due to a carcinoma of the upper part of the esophagus at this level.

c. Lateral body-section view of cervical region. Note localized bulge of the retrotracheal space as a result of carcinoma of the vocal cord with extralaryngeal extension.

range is probably a more accurate manifestation of abnormality of the canal as the result of an expanding lesion. It should be noted, however, that the cervical cord normally occupies only about a third to a half of the sagittal diameter of the canal (Fig. 3). Therefore, sagittal widening would be likely to be due to an extramedullary tumor, as for example a neurofibroma. It is most unlikely that a malignant intramedullary spinal tumor could ever attain sufficient size to enlarge the sagittal canal measurements by bone erosion.

With reference to the posterior boundary of the spinal canal, it should be noted that it normally describes a smooth arc from the posterior arch of the first cervical vertebra

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Fig. 3. Lateral view of upper cervical region made during air myelography. It indicates the relatively small portion of the sagittal diameter of the neural canal occupied by the spinal cord.

downward (Fig. 1). Any abrupt alteration of this smooth contour should be carefully evaluated (Fig. 4, *a* and *b*).

ATLANTO-ODONTOID-BASION RELATIONSHIP

We have noted in the normal cervical portion of the spinal column a constant relationship of the tip of the odontoid process to the basion (midsagittal point of the anterior lip of the foramen magnum) (Fig. 1). The basion is usually recognized without difficulty on an accurate lateral roentgenographic view, but tomography may occasionally be necessary for accurate identification. The middle half of the upper end of the odontoid process normally lies directly beneath the basion, and on an average of 5 mm. from it. In infants and young children, owing to incomplete bone growth, this distance may measure up to 1 cm. Furthermore, the anterior surface of the odontoid is normally within 1 or 2 mm. of the anterior arch of the atlas.

It is our experience that small variations in the aforementioned bony relationships are of considerably more practical significance than are small and even moderate variations in the relationship of the tip of

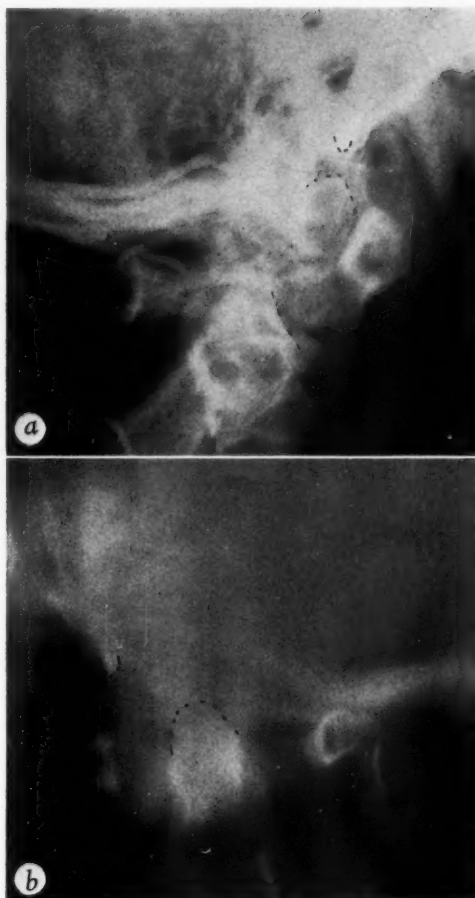


Fig. 4, *a*. Lateral view of upper cervical portion of spinal column. Note the fracture of the odontoid process and that, owing to the fact that the transverse ligament remained intact, the cephalad fragment of the odontoid has maintained a normal relationship to the basion and to the anterior arch of the atlas. The contour of the posterior limit of the spinal canal, however, is interrupted by forward displacement of the first cervical vertebra in relation to the second cervical vertebra.

b. Lateral body-section view of upper cervical region. Note disruption of atlanto-odontoid-basion relationship as a result of traumatic rupture of the transverse ligament of the atlas. Forward displacement of the first cervical vertebra on the second compromises the neural canal. Chiropractic adjustment elsewhere was followed by fairly rapidly progressing paresthesias and numbness in all four limbs.

the odontoid to either Chamberlain's (5) or McGregor's (6) line. In other words, we have frequently found the tip of the odontoid to lie 5 mm. or even 1 cm. above Chamberlain's or McGregor's line in pa-



Fig. 5. Lateral view of head of patient with extensive Paget's disease. Note the high relationship of the tip of the odontoid process to a line corresponding approximately to Chamberlain's or McGregor's line (A). There were no significant neurologic findings.

tients who were neurologically quite normal but, according to certain definitions, would be judged to have basilar invagination (Fig. 5). In actual fact, this latter designation becomes meaningless in such cases and therefore loses much of its practical value.

On the other hand, a variation of 5 or 10 mm. in the relationship of the odontoid to the anterior arch of the atlas or to the basion carries with it, in view of the secondary alterations that occur in the sagittal dimension of the canal at the level of the first cervical vertebra, neurologic implications which are often serious. Alteration of the atlanto-odontoid-basion relationships have been observed in traumatic subluxations of the odontoid with dissolution of the transverse ligament of the atlas (Fig. 4, *b*), in hyperemic atlanto-axial dislocation, in rheumatoid spondylitis and rheumatoid arthritis, and in association with congenital anomalies of the cervical part of the spinal column, particularly occipitalization of the atlas (Fig. 6, *a* and *b*).

We also have found these relationships useful in the evaluation of the status of the upper part of the cervical portion of the spinal column in infants. In this age group the odontoid, basion, and anterior arch of the atlas are easily detected on lateral

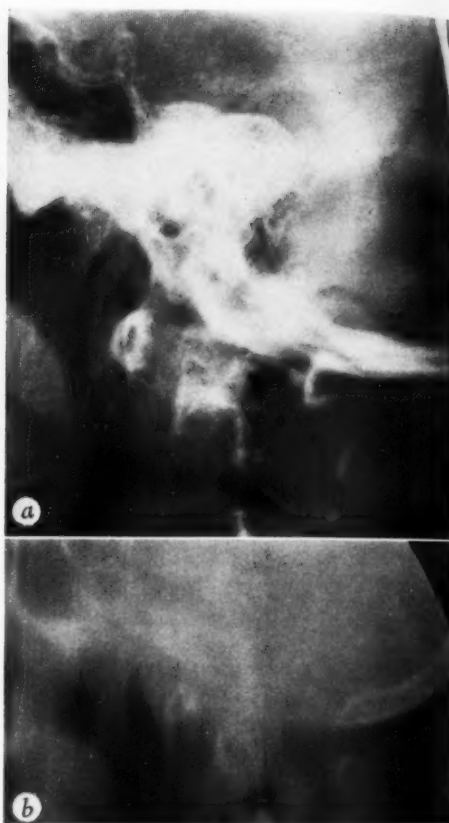


Fig. 6, *a*. Lateral view of upper cervical portion of the spinal column in a patient with rheumatoid arthritis. Note the disruption of the normal atlanto-odontoid-basion relationship, with associated narrowing of the sagittal diameter of the neural canal. The patient has evidence of multiple peripheral neuritis.

b. Lateral body-section view of upper cervical portion of spinal column. Note assimilation of the atlas and disruption of the atlanto-odontoid-basion relationship. The spinal canal, however, is still ample. Results of neurologic examination were negative.

roentgenographic views. On the contrary, the difficulty in deciding where the posterior edge of the hard palate is in patients belonging to this age group may nullify attempts to draw Chamberlain's or McGregor's lines accurately (Fig. 7, *a*).

It should be stated here that the neural canal may be seriously compromised when the odontoid is fractured, while at the same time the cephalad fragment of the odontoid process maintains a normal atlanto-odontoid-basion relationship (Figs. 4, *a* and

7, b). In such cases the normal posterior curve of the neural canal is interrupted and the sagittal diameter of the cervical canal is compromised by forward displacement of the head, the atlas, and the cephalad odontoid fragment as a unit in relation to the cervical part of the spinal column below.

COMMENT

We wish to quote at random, with some comments, a few interesting passages from the paper by Spillane, Pallis, and Jones (7).

1. "Platybasia denotes an increase in the breadth (obtuseness) of the basal angle of the skull which is the angle made by the intersection of the plane of the sphenoid with the plane of the clivus. *Basilar impression* is a deformity of the base of the skull consisting in an elevation into the cranial cavity of a variable part of the bony rim of the foramen magnum."

2. In the series of cases reported by Spillane and his associates, "no case of platybasia was encountered." Nor have we, in a large number of roentgenograms showing abnormalities in the region of the base of the skull, found any in which platybasia was evident.

3. "Isolated basilar impression is usually asymptomatic; a syringomyelic syndrome is the commonest clinical concomitant." We have examined roentgenograms of patients with Paget's disease with evidence of marked basilar invagination (using conventional yardsticks) and found that these patients had no recognizable neurologic symptoms.

4. "Occipitalization of the atlas may also be asymptomatic." We are of the opinion that this anomaly is unimportant as an isolated entity, but it becomes important when associated with a congenitally posteriorly displaced odontoid process with secondary narrowing of the neural canal. Normally the cervical cord occupies a relatively small portion of the upper cervical canal and, as a consequence, considerable narrowing of the canal may occur before neurologic symptoms are produced. However, when congenital cerebellar herniation is present, a lesser degree



Fig. 7. a. Lateral view of cervical portion of spinal column in a normal young child. Observe the normal atlanto-odontoid-basion relationship. Note also the difficulty that might occur in fixing the site of the posterior extremity of the hard palate and consequent difficulty in accurate identification of the base-line by Chamberlain's or McGregor's method.

b. Lateral view of cervical portion of spinal column in a child having a traumatic fracture of the odontoid process. The cephalad fragment of the odontoid, together with the atlas, is displaced forward. Note the abrupt angulation of the posterior border of the spinal canal between the first and second cervical vertebrae. Symptoms and signs of an injury at this level were present.

of narrowing of the canal will produce symptoms than when such herniation is not present.

SUMMARY

Seven hundred normal lateral views of the cervical part of the spinal column from the files of the Mayo Clinic were examined with reference to the retropharyngeal and retrotracheal soft-tissue spaces, the sagittal diameter of the spinal canal, and the inti-

mate relationship of the basion, the tip of the odontoid, and the anterior arch of the atlas. Of these, 600 films were technically adequate and were included in our study.

We suggest that the following alterations in relationships warrant further evaluation of a patient: (a) a retropharyngeal space (measured at the lower border of the second cervical vertebra) of more than 7 mm.; (b) a retrotracheal space (measured at the sixth cervical vertebra) of more than 22 mm.; (c) any abrupt alteration of the relationship of the posterior tracheal wall to the spinal column; (d) any minor variation in the relationship of the odontoid process to the basion and to the anterior arch of the atlas. This last-mentioned relationship is so significant that minor variations are usually indicative of abnormality. In contradistinction, minor and even marked variations of the relationship of the odontoid process to either Chamberlain's or McGregor's line are usually without significance if the odontoid-atlas-basion relationship is maintained. It is suggested that

the odontoid-atlas-basion relationship is of considerably more practical value to the practicing physician than are Chamberlain's and McGregor's lines.

The Mayo Clinic
Rochester, Minn.

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SUMMARY IN INTERLINGUA

Le Roentgenogramma Lateral Del Collo, Con Commentos Super Le Relation Atlanto-Odontoido-Basionic

Septe centos normal vistas lateral del parte cervical del columna vertebral, omnes ab le archivos del Clinica Mayo, esseva examinate con respecto al spatios retropharyngee e retrotracheal de histo molle, al diametro sagittal del canal spinal, e al intime relation inter basion, puncta del processo odontoido, e arco anterior del atlante.

Es opinat que le sequente alterationes de relation require un evaluation additional del patiente in question: (a) Un spatium retropharyngee (mesurate al margine inferior del secunde vertebra cervical) de plus que 7 mm; (b) un spatium retrotracheal (mesurate al sexte vertebra cervical) de plus que 22 mm; (c) omne abrupte alteration del relation inter le pariete tracheal

posterior e le columna vertebral; e (d) omne variation—mesmo minor—in le relation inter le processo odontoido e le basion e le arco anterior del atlante. Iste ultime relation es si significative que minor variationes es usualmente un indication de anormalitate. Per contrasto con isto, minor e mesmo marcate variationes in le relation del processo odontoido con le linea de Chamberlain o con le linea de McGregor es usualmente disprove de signification si le relation atlanto-odontoido-basionic es mantente.

Es opinat que le relation atlanto-odontoido-basionic es considerabilemente plus importante ab le puncto de vista practic del medico que le linea de Chamberlain e etiam de McGregor.

Radiation Dose to the Lens in Treatment of Tumors of the Eye and Adjacent Structures

Possibilities of Cataract Formation¹

GEORGE R. MERRIAM, JR., M.D., and ELIZABETH F. FOCHT, B.A.²

WHEN THERAPY is being planned for tumors of the eye, orbit, or adjacent structures, the question arises frequently as to the amount of radiation that will be delivered to the lens. The dose to this structure must be considered in view of the possibility of a radiation cataract.

In a recent study (1) of 100 radiation cataracts and 73 cases without cataracts following irradiation, phantom measurements showed a few minimum, stationary lens opacities at an estimated dose of 200 r at the lens delivered in a single treatment. A few were also found with 400 r at the lens if this dose were delivered in three weeks to three months. When the treatment time was over three months, the minimum dose that produced a cataract was 550 r.

In this same study the probability of cataracts at various dosage levels was estimated. With a dose range of 40 to 250 r to the lens in three weeks to three months there were no lens opacities in 20 cases. With doses of 350 to 550 r, cataracts developed in 4 of 9 patients. With 550 to 750 r, 6 of 10 patients showed lens changes; with 750 to 950 r, 15 of 25 patients, and with 950 to 1,150 r, 3 of 4 patients. With higher doses to the lens, the incidence of cataracts was 100 per cent. A dose to the lens of approximately 700 r has thus about a 50 per cent chance of producing a cataract. Although the number of cases in some of these ranges was small, the figures give some indication of the expected incidence of radiation cataracts for a given dose delivered in three weeks to three months.

In this same study the effect of dose on the incidence of stationary and progressive lens opacities was investigated for the cases measured. As might be expected, the higher the dose the greater the number of progressive cataracts with resulting loss of vision. Thus, in the group with a treatment time of three weeks to three months, with an average dose of 750 r to the lens, progressive cataracts developed in only 2 of 14 cases. In a group of 20 patients with a dose of 1,450 to 6,000 r all had cataracts and all of these were progressive except 1, which was indeterminate. In the published paper 1 of these 20 cases was listed as stationary, but a subsequent examination showed the cataract to have become progressive. Superimposed senile changes, however, could not be excluded.

It is useful, therefore, to be able to estimate the dose that the lens will receive from a particular treatment. Attempts at calculation are difficult. References to standard isodose curves may give an inadequate estimate. Isodose charts are not available for every quality, field size, distance, and diaphragm system. Moreover, the usual depth dose tables start from a flat surface and are not exactly applicable to the contour of the face, especially the region of the orbit. Within the direct beam, shielding arrangements of various shapes, over part of the surface, further complicate the determination of the dose to the lens. One way in which calculations might be attempted would be by the method of Meredith and Neary (2) or by construction of a Wheatley integrator (3).

¹ From the Head and Neck Service and the Physics Department of the Memorial Center, and the Institute of Ophthalmology, Columbia-Presbyterian Medical Center, New York, N. Y.

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² Now at The New York Hospital-Cornell University Medical Center, New York.



Figure 1

The purpose of the present study was to measure directly the amount of radiation reaching the lens with some of the usual techniques employed in the treatment of tumors of the eye, orbit, and adjacent structures. Many of the factors, doses, and fields employed were outlined by Dr. Ralph Phillips of the Radiotherapy Department of the Memorial Center, New York City. We are indebted to him for his valued assistance. Obviously the results apply only to the treatment conditions used but they may be helpful in estimating the dose to the lens where other plans of therapy are utilized.

METHOD OF INVESTIGATION

For the radiation cataract work, a special phantom (Fig. 1) was devised from a skull of average size coated with a mixture of paraffin and beeswax of unit density. The cranial cavity was filled with bolus. This same phantom was used in the present study. Plastic eyes of unit density were constructed, with holes and grooves so placed that small Baldwin-Farmer condenser ionization chambers could be inserted into the position of the lens. The orbits were filled with wax so that the eyes would rest in their normal positions.

For each plan of treatment multiple readings were taken and frequent checks

made for leakage. The chambers were calibrated for the various qualities of radiation used. Due to individual and age variations in the size and configuration of skulls, the results should be considered an average. These variables are most applicable to the lateral and posterior fields, where the results could differ by perhaps ± 20 per cent for a range of patients. Another uncontrollable variable is due to the fact that near the edge of the beam the penumbra will cause a change of dose with a small change of position. Nevertheless, the results give an indication of the amounts of radiation that may reach the lens under various treatment conditions.

Wherever lead masks were used, they were of 1/16 inch lead. Eye shields were of the same thickness and coated with wax to absorb the secondaries. The shielding for 250 kvp was 1/16 inch lead and for 100 kvp 1/32 inch lead. All eye shields or lead strips used for irregular fields were placed directly on the phantom. When a sliding lead diaphragm was employed for the 250-kvp machine, it was at a distance of 30 cm. from the target. When cones were used, they were in contact with the surface.

The bottom of the 1,000-kvp sliding lead diaphragm system was at a distance of 33 cm. from the target. The lead shields used were about 1/2 inch thick, placed within the diaphragm system.

RESULTS: 1. CARCINOMA OF ANTRUM

The dose to the lens was measured for both 250 kvp plus radium, and for the 1 MVP machine. The factors, fields, and results are shown in Figures 2 and 3.

Technique 1: 250 kvp plus Intracavitary Radium: For this technique the floor of the orbit was considered to be invaded. The eyes were not shielded and the lens on the side of treatment was in the edge of the direct beam. The factors, fields, and dose are shown in Figure 2.

From the anterior field the lens on the treated side received an average of 15 r per 100 r, in air, and from the posterior field

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CARCINOMA OF ANTRUM

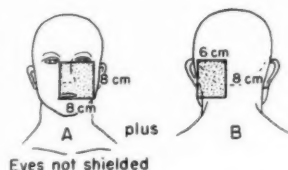
TECHNIQUE I

FACTORS:

250 KVP-HVL 2.0 mm Cu -
50 cm TSD - 2 fields

PLUS

Intracavitary radium -



DOSE AT LENS

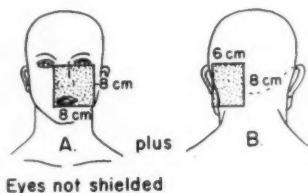
	250 KVP		PLUS	RADIUM		
	r/100r in air		Total for tumor	r/100 mg hrs	Total for tumor	Total for
	A	B	dose of 3000r		dose of 4000r	combined R _x
SIDE OF R _x	15	10	450r	90	2700r	3200r
OPPOSITE EYE	3	2	115r	20	600r	700r

2

TECHNIQUE II

FACTORS:

1000 KVP-HVL 3.4 mm Pb -
70 cm TSD - 2 fields



DOSE AT LENS

	r/100r in air		Total for tumor
	A	B	dose of 6000r
SIDE OF R	45	35	3200r
OPPOSITE EYE	10	5	600r

3

Figures 2 and 3

10 r. Since the chamber was in the penumbra of the beam, the contribution of the anterior field could vary considerably with a given set-up. With this technique, however, as will be seen, the dose to the lens from the radium was itself sufficient to produce a cataract. For a calculated tumor dose of 3,000 r, from equal air doses to both fields, the lens in this instance received approximately 450 r. Since the floor of the orbit was in-

vaded, it was impossible to shield the lens adequately. The opposite unshielded lens received 3 r per 100 r in air from the anterior port and 2 r from the posterior. For a tumor dose of 3,000 r in four weeks this lens received 115 r.

If, with the same anterior field, the eye on the treatment side were shielded with 1.6 mm. lead, the dose from the anterior port to the lens would be reduced about 50 per cent. It would then receive a total

of 320 r. This eye, however, can be shielded only when the floor of the orbit is not involved. Shielding the opposite eye reduced the dose to that lens by approximately 30 per cent. The total dose would be reduced correspondingly to 90 r. The main purpose in shielding the opposite eye is to reduce the amount of scattered radiation from the diaphragm system or direct radiation coming through the tube housing. In the x-ray machines used, the heads had been carefully checked for any leakage of radiation through the tube housing and enough lead had been added to make it less than 1 r/hr. at 1 meter from the target.

In this technique, intracavitary radium was combined with 250-kvp x-rays. One antrum was treated with 50 mg. of radium centrally placed in the sinus. The disease was considered to be at a maximum distance at 2.5 cm. from the source. A dose of 4,000 r was delivered at this distance in two weeks. Readings were taken at the lens of each eye and the results are shown in Figure 2.

The lens on the side of treatment received 90 r per 100 mg. hr., or a total of 2,700 r for this tumor dose. The opposite lens received 20 r per 100 mg. hr., or a total of 600 r for the same tumor dose.

From the combined treatment, with a tumor dose of 7,000 r in six weeks, the near lens would receive a total of 3,200 r, which would mean a progressive cataract. The far lens would receive just over 700 r, in which case there would be approximately a 60 per cent chance of a cataract and perhaps a 20 per cent chance that it would be progressive.

Technique II: 1,000 kvp: As with the previous technique, the floor of the orbit was considered to be invaded. The factors, dose, and fields are shown in Figure 3. The eyes were not shielded and the upper edge of the beam bisected the pupil.

The lens on the treated side received 45 r per 100 r in air from the anterior field and 35 r from the posterior field. This would mean a total of about 3,200 r for a tumor dose of 6,000 r delivered in equal

air doses to both fields. If an attempt were made to have the 50 per cent isodose line bisect the pupil, the dose at the lens would usually be large enough to produce a progressive cataract in the treatment time of six weeks.

The opposite lens would receive 10 r per 100 r in air from the anterior field and 5 r from the posterior port. There would be a total of 600 r to this lens for the same tumor dose.

A rectangular shield of approximately 1.2 cm. lead placed directly on the eye and sufficiently large to cover it adequately reduced the radiation from the anterior field to the lens opposite the side of treatment to about 60 per cent. Such a shield should have at least a few millimeters of unit density material between it and the eye to absorb secondary radiation. The total to this lens from both ports would then be of the order of 450 r. With this dose there would be less than a 50 per cent chance of a cataract. Practically, however, it may be difficult to support a shield of this thickness over the eye.

CARCINOMA OF NASOPHARYNX

Readings were taken at both 250 kvp and 1,000 kvp with two techniques, according to whether or not the ethmoids were considered to be involved. Sliding type diaphragms were used for both machines.

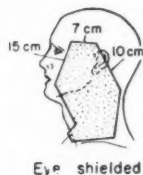
Technique I: Ethmoids Not Involved: If the ethmoids were not involved, the eyes were not included in the beam and were shielded. The factors used for either quality of radiation, the fields, and the dose are shown in Figure 4. As can be seen, the near eye is outside the geometrical edge of the beam.

With the 250-kvp unit, the lens of the eye nearer the beam received 8 r per 100 r in air and the opposite lens 7 r from a single lateral field. The total dose to each lens from both lateral fields was 350 r for a tumor dose of 3,700 r. Equal skin doses were given to both fields. With such a dose to the lens in four weeks a cataract would not be expected.

CARCINOMA OF NASOPHARYNX

ETHMOIDS NOT INVOLVED TECHNIQUE I

FACTORS:



250 KVP-HVL 2.0 mm Cu - 50 cm TSD
2 lateral fields

OR

1000 KVP-HVL 3.4 mm Pb - 70 cm TSD
Same fields

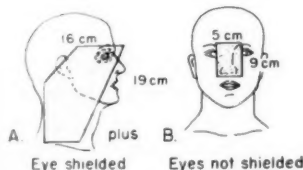
DOSE AT LENS

	250 KVP	OR	1000 KVP
	r/100r in air	Total for tumor dose of 3700r	r/100r in air
SIDE OF R _x	8	> 350r	8
OPPOSITE EYE	7		10
			> 500r

ETHMOIDS INVOLVED

TECHNIQUE II

FACTORS:



250 KVP-HVL 2.0 mm Cu - 50 cm TSD -
2 lateral fields - 1 anterior field

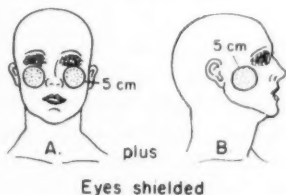
OR

1000 KVP-HVL 3.4 mm Pb - 70 cm TSD
Same fields -

DOSE AT LENS

	250 KVP	OR	1000 KVP
	r/100r in air	Total for tumor dose of 5800r	r/100r in air
	A plus B		A plus B
SIDE OF R _x	14 15-40	> 1000 - 1600r to each lens	14 40-80
OPPOSITE EYE	13 15-40		15 40-80
			> 1900 - 3100r to each lens

TECHNIQUE III



FACTORS:

250 KVP-HVL 2.0 Cu - 50 cm TSD
4 fields

DOSE AT LENS

	r/100r in air	Total for tumor dose of 7800r
	A plus B	
SIDE OF R _x	2 2	> 250r to each lens
OPPOSITE EYE	1 1	

Figures 4-6

If the 1-million volt unit were used with the same laterally opposed fields and a shield of 1.7 cm. in diameter in the diaphragm system, the near lens received 8 r per 100 r in air and the far lens 10 r from a single field. The total to each lens from the two lateral fields was nearly 500 r for a tumor dose of 4,200 r. There would be about a 40 per cent chance that a stationary cataract would develop with this dose delivered in four weeks.

Technique II: Ethmoids Involved: The same two qualities of radiation were employed—250 and 1,000 kvp—when the ethmoids were involved. The fields and tumor doses were as shown in Figure 5. The anterior field extended laterally to the nasal margin of each pupil and thus included the nasal aspect of each lens. The same lead shielding was used as in the previous set-up.

At 250 kvp the lens of the eye nearer the beam received 14 r per 100 r in air and the far lens 13 r from each lateral field (Fig. 5, A). Each lens would receive a total of 600 r from a skin dose of 3,000 r to each of the two fields.

In these patients an anterior port was also used (Fig. 5, B). The nasal portion of each eye up to the edge of the pupil was included in the beam. No attempt was made to shield the eyes. From this field each lens received from 15 to 40 r per 100 r in air, or a total of 400 to 1,000 r for a skin dose of 3,000 r. This range was due to slight variations in the position of the edges of the field with respect to the eye. The total to each lens from the three fields, two lateral and one anterior, was from 1,000 to 1,600 r with a tumor dose of 5,800 r. With this dose in four weeks, a progressive cataract would be anticipated, which may be considered a minor complication compared to the seriousness and extensiveness of the disease being treated.

When the nasopharynx was treated with x-rays produced by a 1,000-kvp unit, the same fields were used as shown in Figure 5, with a lead eye shield of 1.7 cm. diameter in the diaphragm system. The lens of the eye nearer the beam (Fig. 5, A) re-

ceived 14 r per 100 r in air and the opposite lens 15 r from each lateral field. Each lens received 750 r from the two fields for a skin dose of 3,000 r to each. From the anterior port each lens received from 40 to 80 r per 100 r in air, or a total of 1,150 to 2,300 r for a surface dose of 3,000 r. This range was due to slight variations in the position of the field on the head. The total dose to each lens from the three fields may range from 1,900 to 3,100 r for a tumor dose of 6,500 r. A progressive opacity would result from this dose delivered in four weeks.

The addition of a 1.2 cm. lead shield directly on the eye would reduce the dose to the near eye to 65 per cent and to the far eye to 85 per cent. However, this would not alter the total lens dose significantly, since most of the radiation comes from the anterior field, where shielding is not possible.

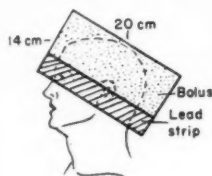
Technique III: This plan of treatment is used by the Head and Neck Department of the Memorial Center, New York City, primarily for cases with a localized ulcer in the nasopharynx. The factors, fields, and dose are shown in Figure 6. Circular cones in contact with the skin were used for all fields. The anterior fields were directed obliquely toward the middle of the nasopharynx, with the upper edges just above the lower orbital margins. The upper edge of the two opposed lateral fields was on a level with the zygoma. The eyes were shielded with 1.6 mm. of lead for all fields.

From one anterior field the lens of the eye on the same side received 2 r and the opposite lens 1 r per 100 r in air. From one lateral field the homolateral lens received 2 r per 100 r in air and the contralateral lens 1 r. The total dose to each lens from the four ports was about 250 r for a calculated tumor dose of 7,800 r from equal air doses to each field. A cataract would not be expected with this dose delivered in four weeks.

If the eyes were not shielded, the dose to the lens on the side of treatment from one anterior port was 4 r per 100 r in air, and the opposite lens received 1 r.

CEREBRAL METASTASES

TECHNIQUE I



FACTORS:

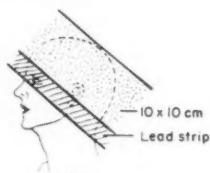
250 KVP-HVL 2.0 mm. Cu-70 cm. TSD -
2 lateral fields.

DOSE AT LENS

	r/100r in air	Total for tumor dose of 4000 r
SIDE OF R_x II		
OPPOSITE EYE 9		450r

TECHNIQUE II - COBALT 60 ROTATION THERAPY -

75 cm. Source - Axis Distance



Dose to each lens: 10r per 100r
in air at axis of rotation

Total: 450r for tumor dose of 3500r

Figure 7

CEREBRAL METASTASES

Readings were taken for two qualities of radiation used for cerebral metastases: 250 kvp and cobalt 60. The factors, fields, and dosage are shown in Figure 7.

Technique I: 250 kvp: For each of the fields, the head was surrounded by bolus. The base of the skull was protected by a lead strip 1.6 mm. thick and about 5.0 cm. wide, and the near eye by a total of 3.2 mm. lead.

From one lateral field the lens of the eye nearer the beam received 11 r per 100 r in air and the opposite lens 9 r. The total dose to each lens from the two fields was about 450 r for a calculated tumor dose of 4,000 r with equal skin doses to each field. With this dose delivered in three to four weeks, there would be about a 40 per cent chance that a small stationary cataract would develop, which would not seriously interfere with vision.

Technique II: Cobalt-60 Kilo Curie Rotating Machine: The port used was 10 x

10 cm., as defined by the 90 per cent isodose line at the tumor, and the field was angled so that the lower edge of the area, swept out during rotation, extended from the base of the occiput to the midfrontal region. The eyes and base of the skull were shielded with 2.5 cm. lead. The source-to-center-of-rotation distance was 75 cm., and the source-to-end-of-diaphragm distance was 27 cm.

Each lens received 10 r per 100 r at the axis of rotation, or a total of about 450 r for a tumor dose of 3,500 r. With this dose in three to four weeks there would be approximately a 40 per cent chance that a small stationary lens opacity would develop.

PITUITARY GLAND

The factors employed were 250 kvp, h.v.l. 2.0 mm. Cu, and 50 cm. target-skin distance. Two opposed 4 x 4-cm. lateral fields and a 4 x 4-cm. anterior field directed at the pituitary were used. Each

lens received 1.7 r per 100 r in air from one lateral field. The dose to the lens from the anterior port was 2.2 r per 100 r in air. The total to each lens was 140 r for a tumor dose of 3,000 r delivered in five weeks, from equal air doses to each field. A cataract would not be expected. Shielding did not reduce the dose, since the radiation to the lens was due to internal scattering.

According to the technique employed by Dr. Harry Burnett, Department of Radiology, New York Hospital, New York City, the pituitary gland was irradiated with a 1,000-curie cobalt unit. The distance from the source to the end of the diaphragm was 27 cm. and the source-skin distance 50 cm. Two opposed lateral temporal fields and a frontal field, all directed at the pituitary gland, were used. Each was 3.5 cm. square at the 50 per cent isodose line on the surface. The dose to each lens was 1.4 r per 100 r in air from the lateral fields and 0.6 r from the frontal field. For a tumor dose of 4,000 r and approximately equal skin doses to all fields, each lens received 90 r, which would not produce a cataract.

LYMPHOSARCOMA OF LACRIMAL GLAND

According to the technique of Phillips, lymphosarcoma of the lacrimal gland was treated with the factors, fields, and dose shown in Figure 8, A and B. The anterior port was directed obliquely and laterally away from the eye, which was rotated nasally. The lateral port was directed posterior to the lens. For both fields 3.5-cm. circular cones were used. No external shields were employed. The dose to the lens was measured for a h.v.l. of 1.0 and also 2.0 mm. Cu, with equal skin doses to each field.

With the 1.0 mm. Cu h.v.l., the dose to the lens was 3 r per 100 r in air from each of the two fields. The total dose to the lens was 35 r for a tumor dose of 1,000 r in seven days. This tumor dose was used only for cases of generalized disease.

When a h.v.l. of 2.0 mm. Cu was used, the lens received 3 r per 100 r in air from

the anterior field and 4 r from the lateral port. The dose to the lens was 40 r for a tumor dose of 1,000 r in seven days. With this technique, there was no significant difference in the amount of radiation to the lens from the two different qualities of radiation. A cataract would not be expected from these small doses.

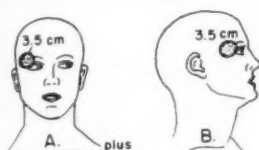
In cases in which it is believed that the tumor has extended outside the lacrimal gland to involve the upper anterior orbit, but which show no evidence of generalized disease, a 4.5- to 5.0-cm. anterior field and a higher tumor dose may be necessary. A special shield of 1.6 mm. lead, as shown in Figure 8, C, was used at the Institute of Ophthalmology, Columbia-Presbyterian Medical Center. The eye was rotated down and nasally so as to shield the cornea, lens, and ciliary body. The same lateral field as shown in Figure 8, B, was used.

The dose to the lens from the anterior port was 8 r per 100 r in air, at a h.v.l. of 1.0 mm. Cu, or a total of 150 r for a tumor dose of 2,500 r from equal air doses to each field. If a h.v.l. of 2.0 mm. Cu were used instead, the dose to the lens was 20 r per 100 r in air, or a total of 350 r for a tumor dose of 2,500 r. A cataract would not be expected with this dose to the lens delivered in three weeks. There was no significant dose to the opposite lens. With this technique the shield just covers the lens, and accurate positioning is essential to avoid a cataract.

LYMPHOSARCOMA OF THE ORBIT

Orbital lymphosarcomas included cases of retrobulbar tumors associated with varying degrees of exophthalmos. At the Institute of Ophthalmology the factors, fields, and dose shown in Figure 9 have been employed. The special shield of 1.6 mm. lead for the anterior port was molded over a plaster cast of the patient's face. The central portion of the shield protected the lid margins, cornea, ciliary body, and lens. The shields were coated with paraffin to decrease the secondary radiation. A 4.5- to 5.0-cm. cone was used for this field.

LYMPHOSARCOMA OF LACRIMAL GLAND




FACTORS:

250 KVP-HVL 1.0 and 2.0 mm Cu
50 cm TSD - 2 fields

Eyes not shielded

DOSE AT LENS

OR



4.5-5.0 cm

A plus B

C

Eye shielded

HVL 1 mm. Cu

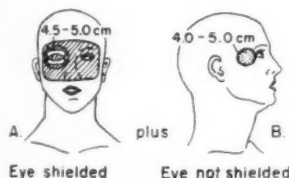
r/100r in air	Total for tumor dose of 1000r	
3		>
3	35 r	
OR		
		Total for tumor dose of 2500r
C	8	>
plus B	3	
		150 r

HVL 2 mm. Cu

r/100r in air	Total for tumor dose of 1000r	
3		>
4	40 r	
OR		
		Total for tumor dose of 2500r
C	20	>
plus B	4	
		350 r

8

LYMPHOSARCOMA OF ORBIT



FACTORS:

250 KVP-HVL 1.0mm or 2.0 mm Cu -
50 cm TSD - 2 fields

DOSE AT LENS

	HVL 1 mm. Cu		OR	HVL 2 mm. Cu	
	r/100r in air	Total for tumor dose of 2500r		r/100r in air	Total for tumor dose of 2500r
ANTERIOR	10	300 r	>	25	600 r
LATERAL	6			10	

9

Figures 8 and 9

With a h.v.l. of 1.0 mm. Cu, the quality of radiation usually employed, the lens received 10 r per 100 r in air from the anterior field. The anterior edge of the lateral field, a 4.0- to 5.0-cm. cone, was on a level with the lateral orbital margin which is approximately at the level of the

equator of the globe. Thus the anterior edge of the beam is posterior to the lens. From the lateral field, the lens on the side of treatment received 6 r per 100 r in air. The total dose to the lens from the two fields was nearly 300 r for a tumor dose of 2,500 r. With this dose in three weeks, a

cataract would not be expected. The opposite lens received about 3 to 4 r per 100 r in air from the lateral field.

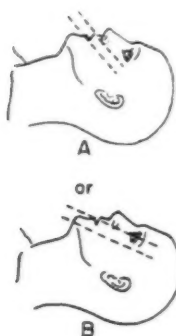
With a h.v.l. of 2.0 mm. Cu, the lens would receive 25 r per 100 r in air from the anterior field and 10 r from the lateral port, for a total of over 600 r for the tumor dose of 2,500 r. This would mean that in a three-week treatment time there would

CARCINOMA OF HARD PALATE

Readings were taken for treatment of carcinoma of the hard palate by x-rays and by radium.

The factors, fields, and dose for 250 krp roentgen rays are shown in Figure 10. The dose to the lens can vary considerably depending on the angle of the cones with respect to the eyes. In the two set-ups

CARCINOMA OF HARD PALATE



FACTORS:

250 KVP-HVL 2.0 mm Cu -
35 cm TSD - 3.0 - 4.0 cm CONE -
Eyes not shielded

DOSE AT LENS

	r/100r in air	Total for tumor dose of 6000r
A	1-2 r	50-100r
or		
B	50r	2500 r

Figure 10

be about a 50 per cent chance of a lens opacity and about a 20 per cent chance that this would be progressive. The opposite lens would receive 6 r per 100 r in air from the lateral field, but there was no measurable dose from the anterior port for either quality, due to the shield. The air dose for the lateral field was approximately twice that for the anterior.

If an additional lead shield 1.6 mm. thick were added to the central portion of the anterior shield for a h.v.l. of 2.0 mm. Cu, the dose to the lens would be reduced from 25 r to 13 r per 100 r in air. This would reduce the total dose to the lens from both fields to approximately 350 r and a cataract would not be anticipated. Further lead would not reduce the dose much more, as the remainder of the radiation represents mainly scatter from the annular beam.

shown, the extremes of angulation were used. From this it is apparent that, when the beam was directed toward one eye but posterior to it, as in Figure 10, A, the lens received only 1 to 2 r per 100 r in air. This would mean a total of 50 to 100 r for a surface dose of 6,000 r delivered in five weeks, which would not produce a cataract.

When the beam was directed through the eye, as shown in Figure 10, B, the lens received 50 r per 100 r in air, or a total of 2,500 r for a surface dose of 6,000 r. From this dose in five weeks a progressive lens opacity would be expected.

When a wax moulage was used on the surface of one side of the hard palate, the near lens received 20 r per 100 mg. hr. and the opposite lens 15 r per 100 mg. hr. Thus, with a small applicator, 2 cm. in diameter, at 0.5 cm. distance, with a

dose of 6,000 r on the surface, the near lens would receive about 100 r and the far lens 70 r. A lens opacity would not be anticipated.

CARCINOMA OF LIDS

Measurements were taken for x-rays, radon seeds, and radium plaques for lesions located in various areas of the lids.

For roentgen irradiation the factors used were 100 kvp, h.v.l. 1.0 mm. Al, 15 to 20 cm. target-skin distance, with cones varying in size from 1.0 to 4.0 cm. The eyes were shielded by 0.8 mm. lead. The highest dose to the lens was 1.0 r per 100 r in air. For doses of 4,000 to 8,500 r in air, the total dose to the lens could come to 85 r, which would not produce a cataract even if delivered in a single treatment. There was no significant difference in the dose for lesions at the inner and outer canthus and near the midportion of the upper or lower lid, since the distance to the lens was essentially the same for each location.

Radon in 0.3 mm. gold seeds was implanted in pieces of cork of varying sizes. These were taped in different positions on the lids, and the dose to the lens was measured. The eyes were not shielded, since for both radon seeds and radium plaques the dose to the lens was reduced by only 1.6 mm. of lead.

A single seed implanted centrally in the lower lid near the margin delivered 550 r per 100 mc. hr. to the near eye and over 15 r per 100 mc. hr. to the far eye. If the seed were as strong as 1.5 mc., this would give 200 mc. hr. if left in permanently, which would deliver over 1,100 r to the near eye. The duration of treatment with radon seeds has been taken as three weeks, in which time about 97 per cent of the total radiation has been given. With this time-dose relationship there would be about an 80 per cent chance of a cataract, with the probability that it would be progressive. The opposite lens would receive about 30 r, which would not produce an opacity.

A single seed in the lower lid at the lateral canthus would deliver about 350 r per

100 mc. hr. to the near lens and nearly 15 r per 100 mc. hr. to the opposite lens.

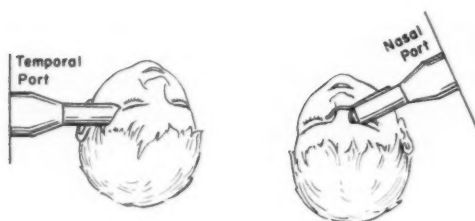
For comparison, the dose from a group of seeds was measured. Thus 5 radon seeds distributed throughout a "tumor" of 1/8 inch of cork, 1 cm. square, placed at the lateral edge of the lower lid, delivered 1,200 r per 1,000 mc. hr. to the near lens. The distance from the center of the group of seeds to the lens measured 2.2 cm. With such a dose, a radiation cataract would be almost certain. The opposite lens would receive 180 r per 1,000 mc. hr. The same group of seeds at the inner canthus, 1.5 cm. from the lens, delivered 2,400 r per 1,000 mc. hr. to the near lens and 200 r per 1,000 mc. hr. to the opposite lens. The former dose would produce a progressive opacity.

Similar groups of 4 seeds in a 2-cm. square, or 7 seeds in a 1.5-cm. square placed on the side of the tip of the nose delivered 350 r per 1,000 mc. hr. to the near lens and 180 r per 1,000 mc. hr. to the opposite lens. A cataract would not be anticipated. The distance from the center of each of these groups of seeds to the lens was measured with dividers. The dose as calculated by the inverse-square law agreed closely with the measured doses for single seeds, or for a group when the distance of the latter was several centimeters from the lens.

A radium plaque of 2 sq. cm., with a 1-cm. spacer in various positions on the lids, delivered from 650 to 850 r per 1,000 mg. hr. to the lens of the near eye. This would mean about a 50 per cent chance of a cataract and about a 20 per cent chance that it would be progressive. The opposite lens received 40 to 180 r per 1,000 mg. hr., and a cataract would not be expected.

RETINOBLASTOMA

About 30 per cent of retinoblastomas are bilateral and the disease is usually considerably more advanced in one eye than in the other. The more involved eye is enucleated and the fellow eye irradiated. In the treatment of this tumor at the Institute of Ophthalmology, two fields have been employed, as shown in Figure 11.



The two fields employed in the treatment of retinoblastoma - a 2.5-cm. temporal and a 2.0-cm. nasal

Figure 11

The anterior edge of the 2.5-cm. circular temporal cone was on a level with the lateral orbital wall, which was approximately at the level of the equator of the eye. Thus the beam was directed posterior to the lens. The 2.0-cm. circular nasal cone was directed from the anophthalmic orbit through the bridge of the nose, at an angle of approximately 28° from the horizontal, with the patient supine so that the edge of the beam passed posterior to the lens. The position of the fields was checked with films for some of the set-ups. The factors employed were 250 kvp, h.v.l. 1.0 and 2.0 mm. Cu, 50 cm. target-skin distance, for an estimated tumor dose of 4,500 r in five weeks.

The dose to the lens from the temporal field for the h.v.l. of 1.0 mm. or 2.0 mm. Cu was 2 to 7 r per 100 r in air for each. The dose to the lens from the 2.0-cm. nasal field was from 2 to 6 r per 100 r in air for a h.v.l. of 1.0 mm. or 2.0 mm. Cu. These ranges were due to variations in the positioning of the fields. The total dose to the lens from the nasal and temporal fields was 130 to 415 r for a tumor dose of 4,500 r delivered in equal air doses. A cataract would not be anticipated with this dose delivered in five weeks.

Infrequently, when each eye contained a small tumor, both were treated through temporal fields only. Measurements to the opposite lens with the 2.5-cm. circular temporal cone showed about 4.0 r per 100 r in air for a h.v.l. of 2.0 mm. Cu, or a total of 130 r for an air dose of 3,200 r in three weeks. The total dose to each lens would

be under 300 r in five weeks, which should not produce a cataract.

Since the anteroposterior and vertical diameters of the globe are about 2.5 cm., the problem of the distribution of radiation throughout the eye with the small 2.5-cm. circular temporal field was considered. Measurements showed notable inequality in the dose to various parts of the eye, particularly between the superior and inferior equatorial regions. Because of this, a new 3.0×4.0 -cm. rectangular temporal cone was devised. Preliminary measurements showed a much more homogeneous distribution of radiation throughout the eye. This study will be published in detail at a later date. The dose to the lens was 8 to 10 r per 100 r in air with the larger cone.

METASTATIC CARCINOMA OF CHOROID OR ORBIT

In the treatment of metastatic carcinoma of the choroid, if a single 2.5-cm. temporal cone were used the dose to the lens would be the same as for retinoblastoma. With the larger, 3.0×4.0 -cm. port, the lens would receive 8 to 10 r per 100 r in air.

In the treatment of metastatic tumors of the orbit, if the fields were the same as described in the treatment of lymphosarcoma of the orbit, the dose per 100 r in air to the lens would also be the same.

SUMMARY

The amounts of radiation reaching the lens from the treatment of tumors of the eye, orbit, and adjacent structures with some of the usual techniques have been measured. The lens doses have been related to the probability of radiation cataracts. The sites of the lesions for which measurements were taken include the antrum, nasopharynx, ethmoids, cerebrium, pituitary gland, lacrimal gland, orbit, hard palate, nose, lids, and the eye itself (retinoblastoma). The problem of shielding has been discussed.

Cataracts were found to be most likely with the techniques used in the treatment of carcinoma of the antrum with invasion

of the floor of the orbit, carcinoma of the nasopharynx with involvement of the ethmoids, and carcinoma of the hard palate only if the cone had to be so angled that the eyes were in the direct beam. In view of the severity of these lesions, however, a cataract is a minor complication. In radiotherapy for carcinoma of the eyelids, a cataract would be likely only if radon seeds or radium plaques were used. In general, the probability of a cataract is high whenever moulages or implants of gamma-emitting radioactive substances are used in the neighborhood of the eye, since it is difficult to shield the lens from such sources. In the x-ray treatment of retino-

blastoma, the complication of radiation cataract can usually be avoided by the use of conservative tumor doses and accurate beam direction.

635 West 165th St.
New York 32, N. Y.

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SUMMARIO IN INTERLINGUA

Dose De Radiation Al Lente In Le Tractamento De Tumores Del Oculo E De Structuras Adjacente. Possibilitate Del Formation De Cataractas

Esseva mesurate le quantitates de radiation que attinge le lente in le tractamento—per medio del technicas usual—del oculo, del orbita, e de structuras adjacente. Le doses al lente esseva relationate al probabilitate del disveloppamento de cataractas de radiation. Le sitos del lesiones pro le quales le mesurationes esseva executate include le antro, le nasopharynge, le ethmoides, le cerebro, le glandula pituitari, le glandulas lacrimari, le orbita, le palato dur, le naso, le palpebras, e le oculo mesme (retinoblastoma).

Esseva trovate que le disveloppamento de cataractas—sub le conditiones del technicas usate—esseva le plus probabile in le tractamento de carcinoma del antro con invasion del fundo del orbita, de carcinoma

del nasopharynge con affection del ethmoides, e de carcinoma del palato dur solamente si le cono debe esser angulate de maniera que le oculos se trova in le fasce directe. In radiotherapia de carcinoma palpebral, un cataracta es probabile solamente quando tubos de radon o placas de radium es usate. In general, le probabilitate de un cataracta es alte quancunque modulages o implantas de radioactive substantias a emission de radios gamma es usate in le vicinitate del oculo, proque il es difficile proteger le oculo contra tal fontes. In le radiotherapia de retinoblastoma, le complication de cataractas per radiation es usualmente evitabile per le uso de conservative doses al tumor e per le accurate direction del fasce.

An Evaluation of the Significance of Transverse Hilar Measurements in the Diagnosis of Primary Lung Cancer¹

GWILYM S. LODWICK, M.D., THEODORE E. KEATS, M.D., and JOHN P. DORST, M.D.

UNILATERAL HILAR enlargement is often the first manifestation of primary carcinoma of the lung. Theoretically, it might be possible to establish certain criteria of measurement to differentiate the normal from the pathologically enlarged hilus. This study was undertaken to evaluate the usefulness of previously established criteria of hilar measurement in the detection of lung cancer.

In a systematic review of the early roentgenograms of 50 cases of carcinoma of the lung, fortuitously made before the development of symptoms, Rigler, O'Loughlin, and Tucker reported that the first roentgen evidence of tumor was unilateral hilar enlargement, a finding present in half of their cases at this early stage. Because this sign was frequently overlooked, they undertook to develop a method of measuring the transverse dimension of the hilar shadows, in an effort to improve the early detection of primary lung cancers by roentgen examination. They established the medial border of each hilus by drawing a vertical midthoracic line bisecting the horizontal transthoracic diameter at the aortic arch and at the diaphragm. The lateral margin of each hilus was determined as the point farthest from the midline but

not including the first branching of each pulmonary artery. Because of the varying interpretation of the position of the lateral margin, these measurements were found not to be entirely objective. Based upon their experience in measuring hilar shadows of 100 normal controls and of 127 patients with carcinoma involving the hilus of the lung, Rigler and his associates concluded that:

- (1) The unilateral hilar shadow is abnormal if over 7.0 cm. in transverse diameter.
- (2) If the sum of both transverse hilar shadows exceeds 13.0 cm., there is less than 10 per cent chance that the subject is normal.
- (3) If the sum of the diameter of the hili is under 11.0 cm., there is little chance of carcinoma being present.
- (4) Forty-two per cent of patients with carcinoma have hilar measurements falling within the upper normal range—between 11.0 and 13.0 cm.

MATERIAL AND METHODS

This discussion of hilar mensuration is part of a larger study of the roentgen characteristics of 541 cases of clinically

TABLE I. HILAR MEASUREMENTS IN PRIMARY CARCINOMA OF THE LUNG

Location	No. of Cases	Per Cent Less than 11.0 cm. T.T.D.*	Per Cent Greater than 13.0 cm. T.T.D.*	Per Cent Greater than 7.0 cm. U.H.M.†
"Negative" chest	31	16.1	19.4	19.4
Hilar	44	6.8	38.6	45.5
Mid and peripheral	94	21.3	19.1	20.2
Hilar and mid or all three	201	11.2	38.3	45.3
TOTAL	370	13.5% av. for all groups	31.9% av. for all groups	36.8% av. for all groups

* Total transverse diameter.

† Unilateral hilar measurement.

¹ From the Department of Radiology, University of Missouri School of Medicine, Columbia, Mo. (Doctors Lodwick and Keats) and the Department of Radiology, University of Iowa College of Medicine, Iowa City, Iowa. Presented in part at the Forty-third Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 17-22, 1957.

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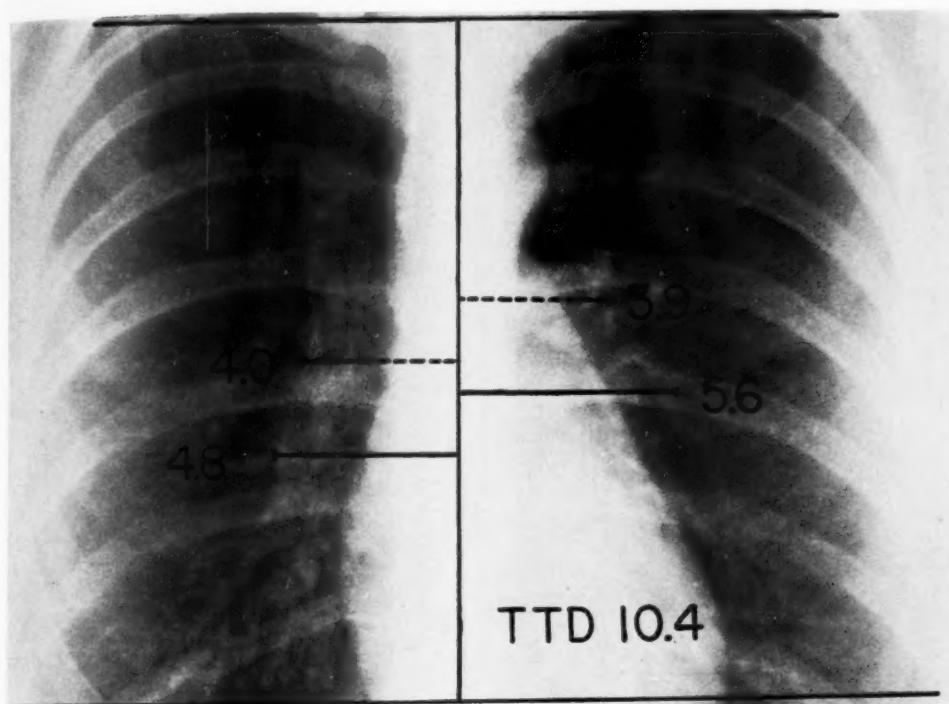


Fig. 1. Roentgenogram of the chest showing method utilized in measuring hilar shadows. The dotted lines represent the least hilar measurements, the solid lines the greatest hilar measurements.

or pathologically diagnosed primary lung cancer from the files of the University of Iowa and the Veterans Administration Hospital in Iowa City.

In applying the system of Rigler and his co-workers to our material, we experienced uncertainty, as did they, as to the exact lateral point on the hilus from which each measurement should be made. We elected to make two separate hilar measurements in each case, one from the point of bifurcation of the pulmonary artery on either side, representing the least hilar measurement, and the other from the point farthest out on the hilus on either side, representing the greatest hilar measurement (Fig. 1). In the final analysis, we chose to use the greatest hilar measurement in the belief that it most closely approximated that of Rigler and afforded the greatest possible validity to the study.

Complete hilar measurements were ob-

tained in 370 cases. We have divided each lung field into three zones in order to evaluate the influence of location of the primary lung cancer upon diagnosis of the lesion or survival of the patient. These zones are the central or hilar zone, the midlung zone, and the peripheral lung zone (Fig. 2). Because of the separation of cases upon the bases of the location of the primary tumor, we find it possible to report our results in four groups (Table I). In the first group, 31 cases, the films were essentially negative. In this group the total transverse measurement of the hilar shadow was greater than 13 cm. in 19.4 per cent, and unilateral hilar enlargement (greater than 7.0 cm.) was observed in a similar percentage; in 16.1 per cent of this group the total transverse diameter was less than 11 cm., a measurement which by Doctor Rigler's criteria probably excludes carcinoma (Figs. 3 and 4).

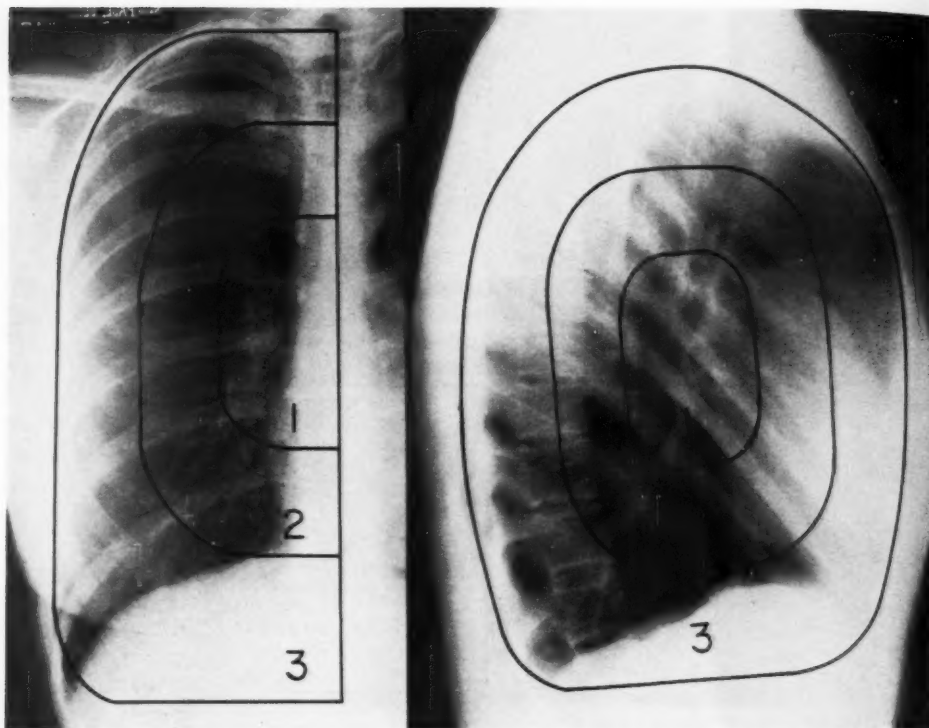


Fig. 2. Postero-anterior and lateral roentgenograms of the chest showing zonal divisions of the lung used in this study: 1. Hilar zone. 2. Mid zone. 3. Peripheral zone.

In the second group, of 44 carcinomas, the neoplasm was limited in location to the hilar zone. This group shows enlarged total transverse measurements in 38.6 per cent of the cases and unilateral hilar enlargement in 45.5 per cent, which accords with Rigler's experience with early roentgenograms of 50 cases of carcinoma of the lung observed prior to development of symptoms. In this group the number of cases with total transverse measurements of less than 11.0 cm. is low (6.8 per cent). On the other hand, the incidence of enlarged transverse hilar measurements and unilateral hilar enlargement is the same as in our largest group, in which the tumor involved the hilar and mid or all three zones of the lung.

In the third group, of 94 carcinomas, the location of the tumor as demonstrated on the roentgenogram is limited to the mid and peripheral lung zones on both the

postero-anterior and lateral films. In this group the incidence of greater-than-normal total transverse measurements is 19.1 per cent, and of unilateral hilar enlargement 20.2 per cent; 21.3 per cent of the cases had hilar measurements less than 11.0 cm.

In the fourth group, numbering 201 cases, the carcinoma involved two or more zones of the lung field, including the hilar and mid or the hilar and two other zones. Of this group, 38.3 per cent showed total transverse measurements in excess of 13.0 cm., and 45.3 per cent showed evidence of unilateral hilar enlargement.

DISCUSSION

In considering all cases of carcinoma of the lung, regardless of location, we find that the total transverse hilar measurement is greater than normal in 31.9 per cent of our cases, and that the unilateral hilar measurement is greater than normal

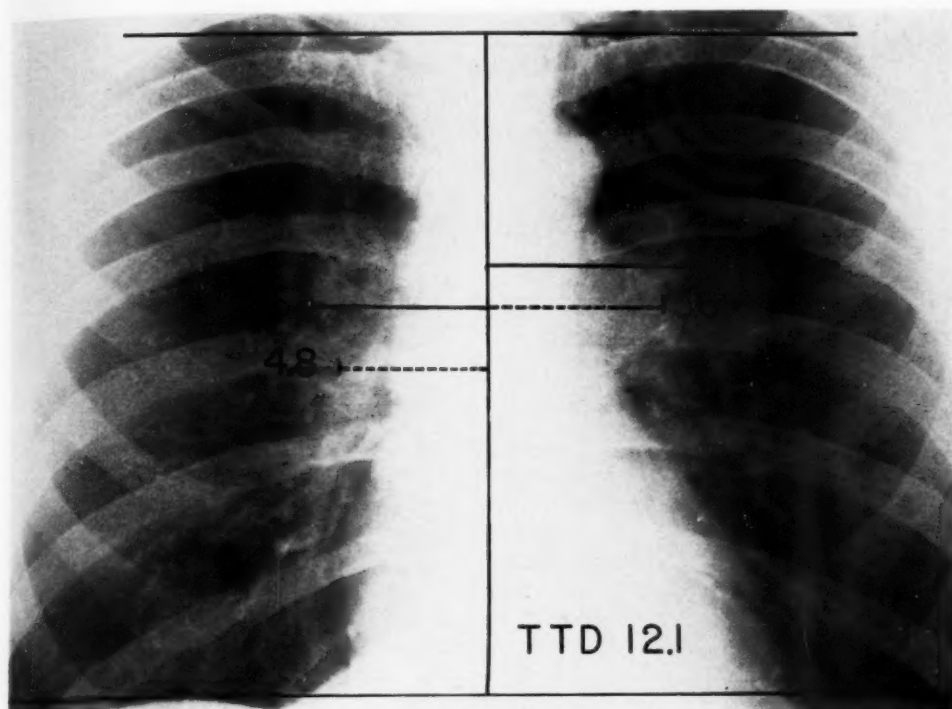


Fig. 3. Normal hilar measurements in a patient with proved carcinoma of the right main bronchus.

in 36.8 per cent. Conversely stated, in from 63 to 68 per cent of all cases of known primary lung cancer, the most generous hilar measurements are within the range of normal. In addition, 13.5 per cent of our known cases of lung cancer have total transverse hilar measurements of less than 11.0 cm., a range said to exclude the presence of cancer of the hilus.

In considering cases of lung cancer segregated into groups based upon location, we find that the group of recognizable hilar cancers and the group of advanced cancers involving the hilus and other zones of the lung have quite similar hilar measurements. While these groups have enlarged hilar measurements less frequently (45.3 per cent abnormal) than Rigler's tumor group (58 per cent abnormal), they more closely approximate his material than do the other groups of lung cancer. In the group of very early lung cancers, where the tumor is not readily apparent in the roentgenogram, and where

hilar measurements could be of greatest help in making a diagnosis, these were abnormal in only 19.4 per cent. One therefore should not take comfort in the presence of normal hilar measurement in eliminating the possibility of an obscure pulmonary neoplasm. Even when the presence of neoplasm is obvious, in our experience two-thirds of the hilar measurements are normal.

We do not wish to minimize the importance of unilateral hilar enlargement as an early sign of lung cancer, but only to point out that normal hilar measurements by no means exclude a clinically detectable neoplasm, or even an enlarged hilus.

SUMMARY

In a large series of lung cancers hilar measurements were found to be within the normal range in two-thirds of the cases. In those patients with lung cancer in whom no neoplasm was obvious in the roentgenogram hilar measurements were

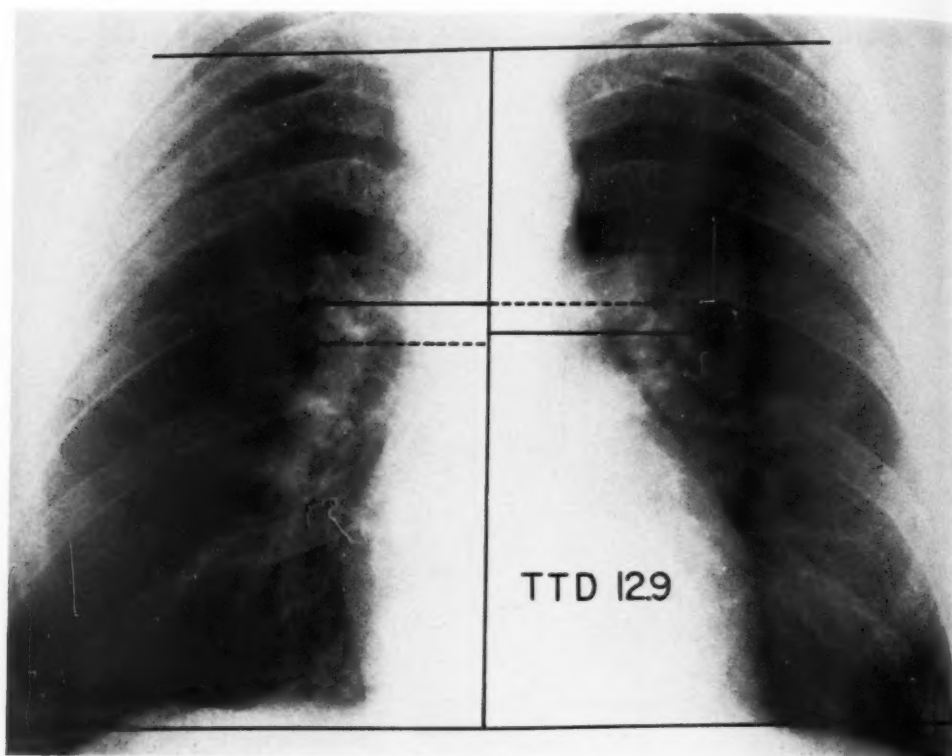


Fig. 4. Normal hilar measurements in a patient with proved carcinoma of the right upper lobe.

abnormal in only 19.4 per cent. Normal hilar measurements should therefore not mislead the observer to the assumption that a neoplasm is not present.

NOTE: The authors wish to express their appreciation to Dr. Johann L. Ehrenhaft of the Department of Surgery and Dr. Eugene F. Van Epps of the Department of Radiology, State University of Iowa, for making this material available, and for their assistance, and to Mr. Edward Wieben of the

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School of Medicine
University of Missouri
Columbia, Mo.

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SUMMARIO IN INTERLINGUA

Un Evalutation Del Signification De Mesuraciones Hilar Transverse In Le Diagnose De Cancere Pulmonar Primari

In un studio de 370 casos de demonstrate carcinoma del pulmon, le autores del presente reporto trovava que le total mesuration transverse del hilo esseva plus que normal in solmente 31,9 pro cento del casos e que allargamento unilateral esseva presente in 36,8 pro cento. In altere parolas, in inter 63 e 68 pro cento de casos de demonstrate cancere primari del pulmon

le mesuraciones hilar esseva intra le limites normal. In plus, 13,5 pro cento del casos habeva total mesuraciones hilar transverse de minus que 11,0 cm, lo que ha essite interpretate como prova del absentia de cancere. Per consequente, normal mesuraciones del hilo pulmonar non debe seducer le observator a concluder que un neoplasma non pote esser presente.

Reversible Bronchiectasis¹

SIDNEY W. NELSON, M.D., and ANTHIMOS CHRISTOFORIDIS, M.D

IN THE OHIO State University Health Center during the past few years an effort has been made to demonstrate bronchographically all of the bronchopulmonary segments in patients suspected of having bronchiectasis. Furthermore, in order to determine whether or not there has been progression of the disease, we believe a careful repetition of the bronchogram is advisable immediately prior to contemplated operation if several months have elapsed between the original bronchographic study and the admission for elective surgery. As a result of this practice, we have seen, during a fifteen-month period, 4 patients in whom a later bronchogram showed complete disappearance of bronchiectasis which had been clearly evident on the previous examination. It is the purpose of this paper to emphasize the fact that bronchiectasis may in some instances be reversible, particularly in children and young adults who have had the benefit of modern medical therapy before the occurrence of destructive changes in the musculo-elastic tissues of the bronchial wall.

There is no doubt that progress in lung surgery and the use of antibiotics have been the factors responsible for the remarkable improvement in the prognosis of bronchiectasis, which ranks second only to tuberculosis among the chronic lung diseases. When there has been destruction of the musculo-elastic skeleton of the bronchial wall, with subsequent permanent dilatation of the bronchi, the only curative treatment is the surgical excision of the involved area. It is difficult, however, to assess clinically and radiologically the extent of permanent damage in some cases. In the study of surgical and postmortem specimens, it has been noted that the dilated bronchi were sometimes micro-

scopically and grossly intact, except for inflammatory changes. Therefore, from the strict pathological standpoint, it is understandable that a return to normal is possible if intensive medical therapy is successful in alleviating the infection before actual tissue destruction has occurred.

ETIOLOGIC MECHANISMS AND FACTORS INFLUENCING REVERSIBILITY

Bronchiectasis has been the subject of many papers since its first description by René Laennec in 1819. Its pathogenesis is highly controversial, because of the simultaneous presence of several causative factors, none of which by itself can explain the disease, and all of which together probably eventually play a role, regardless of which occurs first or seems to be the most important in any given case. It is not the purpose of this paper to dwell at length on the controversies of pathogenesis, but rather to consider the causative factors in the light of a possible reversibility following early and vigorous treatment by modern therapeutic regimens.

Laennec believed that the main etiologic mechanism in bronchiectasis was the increased intrabronchial pressure due to retained secretions. Croxatto *et al.* (3), in a recent experimental study, re-emphasized the importance of increase of pressure within the bronchi as the cause of their dilatation. Many writers have thought that during the act of coughing the intrabronchial pressure is increased, and believed, therefore, that a chronic cough is thus related to the pathogenesis of bronchiectasis (12). That this hypothesis is incorrect was pointed out by Andrus (1), Di Rienzo (4), and Fleischner (6), who showed that the pressure within the bronchi during cough, which is a forceful

¹ From the Department of Radiology, The Ohio State University Health Center, Columbus, Ohio. Accepted for publication in February 1958.

expiratory act, is less than it is in the surrounding alveoli, and the surrounding lung parenchyma therefore tends to compress the bronchi rather than dilate them during the coughing act. Furthermore, there must be air in the alveoli distal to a given bronchus if the cough mechanism is to function in expelling secretions and inflammatory exudates from that bronchus. Thus, it appears reasonable that an *ineffective* cough mechanism following the absorption of alveolar air in atelectasis would play a more important role in the production of stasis, secondary infection, increased volume of intrabronchial contents, and dilatation, than would a normal cough mechanism!

Other authors have pointed out the significance of infection in the development of bronchiectasis. Inflammatory changes secondary to infection result in damage to mucous membrane, smooth muscle, elastic fibers, and cartilage. Early in the course of the disease, when islands of healthy tissue are still present, the damage is repairable. This is undoubtedly the most important factor in explaining the cases of reversible bronchiectasis to be reported here. Although bronchiectasis develops, the effective antibiotic therapy eliminates the infection before irreparable damage occurs. In the vast majority of resected specimens showing bronchiectasis, inflammation is present, and this is felt by Robinson (13) to be the most important factor. No specific organisms have been found which can explain the destructive changes in the bronchi.

Jennings (7), who was one of the first to suspect the reversibility of bronchiectasis, thought that atelectasis was the most important factor in the production of the disease. The negative intrathoracic pressure which develops in cases of atelectasis has been considered a bronchial dilating factor, as has been emphasized by Fleischner and Mallory (10). The close relationship between obstruction and infection is well known, and in atelectasis these factors result in a "vicious circle," each seeming to perpetuate and enhance the other.

It is pertinent to mention here that atelectasis due to the accumulation of mucous or mucopurulent secretions is of frequent occurrence in infants and young children, probably because the collateral ventilation through the pores of Kohn is not yet developed. The lack of aerated alveoli distal to the bronchi in atelectatic lung renders the cough mechanism ineffective, since no current of air can be generated to help rid the bronchi of secretions, which then accumulate and become secondarily infected. Bronchiectasis occurs during atelectasis but is entirely reversible if it resolves before long standing infection can cause permanent damage to the bronchial wall. It is of interest to note that bronchiectasis is most common in the lower lobes, where atelectasis is also most common, and in which location gravity contributes to ineffective expectoration of secretions.

When pneumonia exists for a prolonged period, pulmonary fibrosis may develop, with permanent loss of volume in the fibrotic lung parenchyma and resultant dilatation of the bronchi. This cause is believed to explain the bronchiectasis which exists in many cases of chronic tuberculosis, which disease should always be suspected as the most likely etiologic mechanism when bronchiectasis is found in the upper lobes or apices of the lower lobes.

CASE REPORTS

The following 4 case reports represent instances of reversible bronchiectasis in patients seen on the thoracic surgery service for contemplated excisional therapy between June 1954 and October 1955.

CASE I: W. F., a 17-year-old white male, was admitted to the Ohio State University Hospital on Aug. 14, 1955, with the diagnosis of bronchiectasis. He stated that he had been well until the week of July 4, 1955, when he was treated with penicillin at another institution for what clinically and radiologically appeared to be an acute episode of left lower lobar pneumonia. The cough which began during the acute illness persisted and he had been expectorating moderate amounts of yellow sputum following treatment of the pneumonia. On July 20, only sixteen days following the onset of the pneu-

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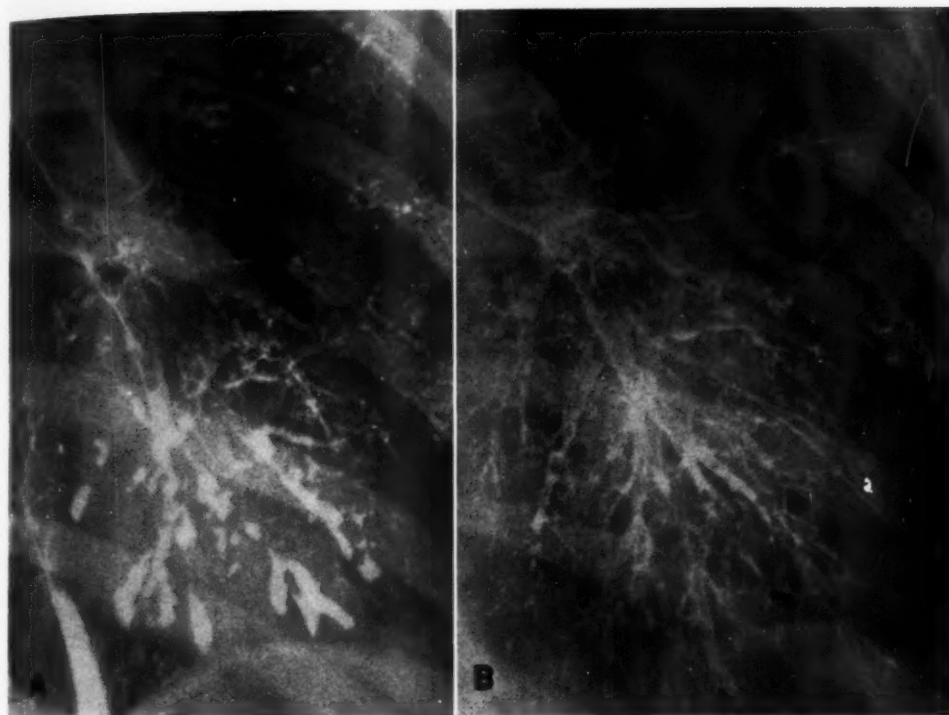


Fig. 1. A. Bronchogram made two weeks following episode of acute pneumonia, showing tubular and fusiform type bronchiectasis of all of the basal segmental bronchi of the left lower lobe.

B. Bronchogram, made five weeks following acute pneumonia episode, showing normal left lower lobe bronchi.

monia, a bronchogram showed bronchiectasis involving all the basal segments of the left lower lobe. There had been a weight loss of about 10 pounds during the illness. The patient therefore entered our hospital for surgical treatment.

Physical examination and routine laboratory studies were not remarkable. The patient brought with him his previous bronchograms, which definitely showed bronchiectasis of all of the basal segmental bronchi of the left lower lobe (Fig. 1, A). The right bronchial tree had not been examined originally, and it was therefore decided to repeat the bronchogram. Much to our surprise, a normal bilateral bronchogram was obtained, showing complete regression of the bronchiectatic changes in the left lower lobe (Fig. 1, B). Surgery was therefore canceled.

Comment: It is well known that some cases of acute pneumonia are slow to resolve due to such factors as general host resistance, the type of organism and its resistance to antibiotic or chemotherapeutic agents, inadequate treatment, etc. Bronchiectasis developing in such cases of

slowly resolving acute pneumonia is probably almost always reversible and the involved bronchi will return to normal if the infection responds before irreversible damage has occurred. In this case there was no previous history of respiratory trouble, and the bronchiectasis disappeared sometime in the twenty-five-day interval between the first bronchogram, July 20, 1955, and the second admission for contemplated surgery, Aug. 14, 1955.

In cases of slowly resolving acute pneumonia it would seem that the best clinical judgment would indicate a conservative approach and not consider surgical treatment of the bronchiectasis until several months of vigorous medical therapy have failed to reverse the process. Furthermore, it is doubtful that a bronchogram is necessary or helpful as early as two weeks following the onset of an acute, but slowly resolving, pneumonia in children

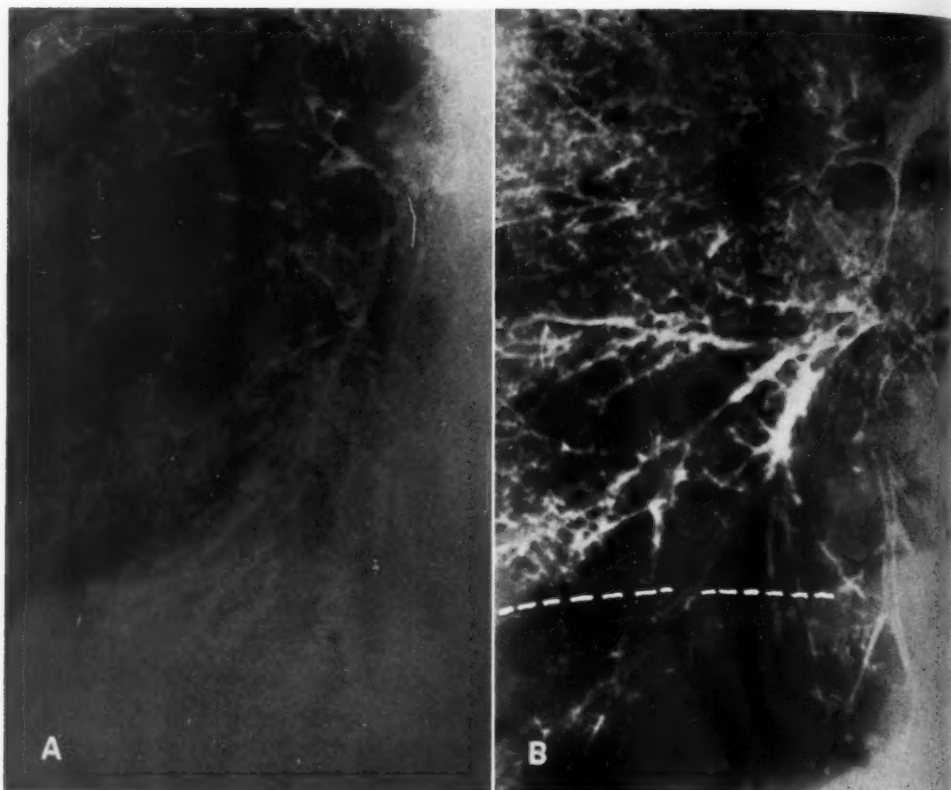


Fig. 2. A. Bronchogram, made two weeks after acute right lower lobar pneumonia, during sixth month of pregnancy, showing tubular bronchiectasis of all basal segmental bronchi of the right lower lobe. The elevated right hemidiaphragm partly obscures the contrast-filled bronchi and indicates considerable atelectasis, which also accounts for crowding together of the dilated bronchi.

B. Bronchogram made three months after delivery and six months after acute episode of pneumonia. Radiographic centering identical to that in view on left, with dotted white line indicating position of right hemidiaphragm comparable to its position in view on left. Bronchi are now of normal caliber and normally distributed, with right hemidiaphragm in normal position.

and young adults who have no history of previous chronic respiratory symptoms.

CASE II: Y. H., a 28-year-old female, was admitted in April 1955 with the history of an acute onset of anorexia, malaise, cough, dyspnea, chills, and fever a few days prior to admission. The white blood cell count was 13,500, with 52 per cent polymorphonuclear leukocytes. Chest films showed opacification of the right lower lobe, with elevation of the right hemidiaphragm, indicating a considerable degree of atelectasis, in addition to the pneumonia. Penicillin therapy resulted in prompt disappearance of the acute symptoms, although the cough persisted and the radiographic appearance of the right lower lobe did not improve. Consequently a bronchogram was done two weeks after the acute episode. This showed bronchiectasis of all of the basal segmental bronchi of the right lower

lobe, which still appeared somewhat atelectatic (Fig. 2, A). The patient was about six months pregnant, and it was decided to postpone lobectomy until after her delivery, which occurred without difficulty in June 1955.

In October 1955, the patient was admitted for contemplated surgery. She was asymptomatic, and physical examination and laboratory studies were not remarkable. Chest films were normal, showing complete disappearance of the right lower lobe changes. A repeat bronchogram on Oct. 16 showed a normal bronchial tree (Fig. 2, B). The contemplated surgery was canceled and the patient was discharged without additional treatment.

Comment: This patient had a long history of cough, and the original bronchogram was justified because it was surmised that she may have had bronchiectasis or a

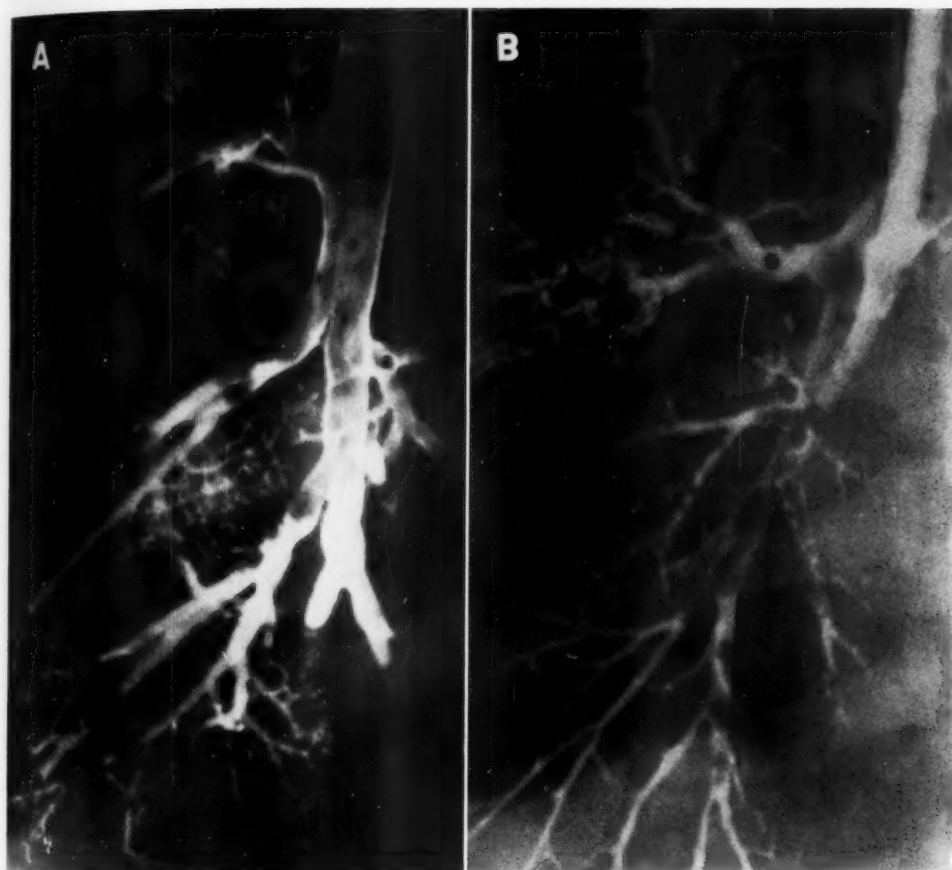


Fig. 3. A. Bronchogram made following an episode of acute pneumonia, showing fusiform and tubular bronchiectasis involving the medial and posterior basal segments of the right lower lobe.
B. Bronchogram made six months later, showing normal appearance of all right lower lobe bronchi.

bronchial adenoma, either of which may have precipitated an episode of acute pneumonia and atelectasis. When bronchiectasis was found, it was therefore assumed to be related to the long history of productive cough, and surgery was felt to be advisable. It was fortunate that a second bronchogram was obtained six months later, before the contemplated operation.

CASE III: J. O., a 10-year-old schoolboy, was admitted for the second time to University Hospital on June 21, 1955, for evaluation of the progress of a previously diagnosed bronchiectasis prior to elective surgery. During the preceding few years he had had frequent severe acute upper respiratory

infections, with an almost constant cough between these episodes. The cough was described as "moist," but the patient actually raised very little sputum and was thought to have swallowed rather than to have expectorated it. Observed in the hospital, it was thick and mucopurulent but never bloody.

The patient had previously been admitted to the University Hospital following an episode of acute pneumonia in December 1954. Bronchograms at that time showed bronchiectasis of the medial and posterior basilar segments of the right lower lobe (Fig. 3, A). In the following six months, the respiratory symptoms had not improved, although there had been a gain in weight and school attendance had been regular.

The patient was a well developed boy who coughed frequently but produced no sputum. Physical examination was normal. Laboratory studies of

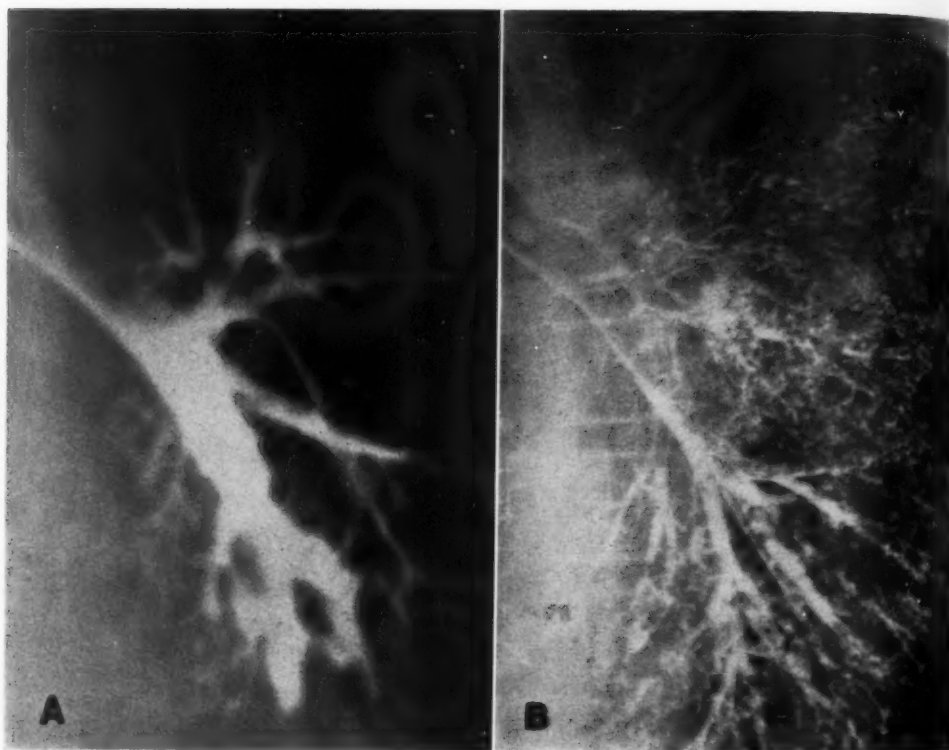


Fig. 4. A. Bronchogram made because of chronic productive cough, showing tubular and fusiform bronchiectasis of basilar segments of left lower lobe.

B. Bronchogram made one year later, showing normal left lower lobe bronchi.

the blood and urine upon admission showed no abnormalities. On June 23, 1955, a repeat bilateral bronchogram, obtained under light general anesthesia, showed no evidence of bronchiectasis (Fig. 3, B). For this reason the operation was canceled and the patient was discharged, to be treated with a medical regimen.

Comment: This case again shows that bronchiectasis occurs during acute pneumonia, and a long standing cough does not necessarily indicate that bronchiectasis was the cause for the cough or the acute pneumonia. Bronchiectasis diagnosed by bronchography during an episode of acute pneumonia must be assessed with optimistic caution, particularly in young children with a history of "recurrent upper respiratory infections and cough." The dilated bronchi in this patient returned to normal radiographically and, although the cough persisted, it is not probable that the

surgical removal of the temporarily dilated bronchi would have removed the source of so common a childhood respiratory symptom.

CASE IV: D. B., an 11-year-old schoolgirl, was admitted to University Hospital on June 13, 1955, for the second time for re-evaluation of a previously diagnosed bronchiectasis. She had had a chronic productive cough with frequent severe upper respiratory infections, which had caused her to miss school frequently. The sputum was moderate in amount, thick and purulent, with no associated hemoptysis. These symptoms had resulted in a previous admission to University Hospital in June 1954, at which time a bronchogram showed left lower lobe bronchiectasis (Fig. 4, A).

Physical examination on re-admission showed a slender young girl in no acute distress. The blood pressure was 105/64, pulse rate 84. The chest was symmetrical, with good expansion bilaterally and with no adventitious sounds. The heart, abdomen, and extremities were normal. Laboratory studies were normal. On June 15, 1955, a repeat

bilateral bronchogram was done, and this showed normal bronchial filling without evidence of bronchiectasis (Fig. 4, B). In view of these findings it was decided that surgery was not indicated and the patient was placed on treatment with positive pressure, penicillin and streptomycin, and aerosol inhalations. On this regimen her cough improved immediately and she was discharged on her third hospital day.

Comment: The original bronchogram was done because of chronic productive cough, and it was no surprise to see the bronchiectatic changes. However, we were somewhat astonished when the second bronchogram before contemplated surgery showed normal bronchi. Furthermore, the symptoms responded dramatically to adequate medical therapy and there is reason to be fairly optimistic about this child's future course.

RADIOLOGIC SIGNS OF REVERSIBLE TYPES OF BRONCHIECTASIS

The radiological manifestations of bronchiectasis of the cylindrical, fusiform, saccular, and "leafless tree" types are well known. The question arises as to whether it is possible to diagnose radiographically reversibility of bronchiectasis by careful study of the diseased bronchi. This is a difficult question to resolve, although there are signs indicating reversibility in at least a small number of patients: Di Rienzo first pointed out that with intact bronchi during the act of cough a swift peristaltic wave runs from the small bronchi toward the trachea. When the mucous membrane and the musculo-elastic elements are still intact, the contrast medium can be moved and expelled, whereas if there is destruction of the above mentioned structures, the peristaltic wave cannot originate in the bronchi and the cough is ineffective. This sign, although helpful, is difficult to study and is not absolute, because other factors may interfere with bronchial peristalsis during the act of coughing, e.g., the mechanical stress and strain of the surrounding parenchyma on the bronchial wall.

The varicose and fusiform appearances of dilated bronchi, although not pathogno-

monic of reversibility, are the radiographic changes usually seen in the reversible cases of bronchiectasis (Figs. 1, A; 2, A; 3, A; 4, A). In these types of the disease the narrowing at the origin of the segmental bronchi or of the third or fourth bronchi (which is attributed to spasticity of circular elastic and muscular fibers due to inflammation), indicates that the circular elastic and muscular elements are still present, a sign which speaks for reversibility. Furthermore, the bronchiectasis distal to such localized areas of spasticity might be largely due to stasis and increased intrabronchial pressure as a result of accumulation of secretions. Theoretically the relief of such localized areas of bronchospasm should result in reversal of the bronchiectasis if the bronchi were intact and the bronchial inflammatory reaction alleviated.

None of the above discussed criteria is absolute, however, and we believe the most reliable evaluation of reversibility is made by serial bronchography with the presently available quickly eliminated contrast media. There is no doubt that bronchography is the best means of diagnosing and following the course of bronchiectasis *in vivo*.

CONCLUSION

In our institution, due to the increased use of bronchography for the study of pulmonary diseases, we have recently seen bronchiectasis in 4 patients at a stage when it was still reversible, as proved in subsequent bronchograms. It is important for the radiologist to recognize and emphasize to his clinical colleagues that bronchiectasis in its early stages is frequently a reversible process, particularly in children and young adults following acute pneumonia and atelectasis. Therefore, before surgical excision is contemplated, thorough medical management, including antibiotics, postural drainage, breathing exercises, etc., should be tried. Careful and thorough bronchography is the most reliable and practical diagnostic method for detecting bronchiectasis, and

repeated bronchographic studies should be done in order to follow accurately the course of the disease.

NOTE: Figures 3, A and 4, A are spot-films in which the shorter tube-film distance causes angular distortion, accentuating the pathological findings. All other views are teleroentgenograms.

Department of Radiology
Ohio State University
Columbus 10, Ohio

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SUMMARY IN INTERLINGUA

Bronchiectasis Reversibile

Gratias al augmentate uso del bronchographia in le studio de morbos pulmonar, le autores ha vidite in recente tempores quatro patientes con bronchiectasis in un stadio quando illo esseva ancora reversibile. Iste reversibilitate esseva provate per bronchogrammas subsequente. Il es importante pro le radiologo recognoscer (e sublinear pro su collegas clinic) que bronchiectasis—ante le supervenientia de alterationes destructive in le histos musculo-elastic del parietes bronchial—es frequentemente un processo reversibile, particularmente in juveniles e juvene adultos post

acute pneumonia e atelectasis. Ante que un excision chirurgic es prendite in consideration, un meticulose regime medical—including antibioticos, drainage postural, exercitios respiratori, etc.—deberea esser tentate.

Un apparentia varicose e fusiforme del dilatate bronchos non es pathognomonic sed se vide usualmente in casos que es ancora reversibile. Tamen, le methodo le plus digne de confidentia in le evaluation del reversibilitate, es bronchographia serial con un substantia de contrasto a elimination rapide.

Increasing Scope of Bronchography with Dionosil¹

CAROLINE W. ROWE, M.D.²

PRIOR TO 1955, Iodochlorol was used routinely in the radiography of the bronchial tree at the John Sealy Hospital, University of Texas, Medical Branch, in Galveston. With few exceptions, bronchography was considered to be indicated only for confirmation of the diagnosis of suspected bronchiectasis and for the subsequent preoperative mapping of all the lobes. Alveolar retention for many months tended to mask future lung infiltrations, prevented early re-examination, and even resulted in delay in performing surgical procedures.

With a rapidly absorbable medium, these objections are overcome. We chose to use Dionosil, which is completely absorbed in the average patient in one to four days. With the adoption of this opaque medium, we began to apply bronchography to the study of chest diseases of all types. During the first two years we performed 400 bronchographic examinations, an analysis of which is presented here.

As we began to increase the scope of bronchography, it became apparent that the successful interpretation and usefulness of the procedure depended on obtaining complete visualization of the peripheral bronchioles as well as of the larger bronchi. With this strict criterion for a satisfactory bronchogram, we found that in approximately one-fourth of the examinations filling was incomplete and re-examination was required. It was felt, therefore, that a discussion of some of the problems encountered in attempts to obtain complete visualization might be worthwhile.

All patients except children who were too young to co-operate were given preoperative medication and local anesthesia with 1 per cent Pontocaine. The opaque medium was introduced through an endotracheal catheter, the tip of which had

been placed in the desired location under fluoroscopic visualization. The catheter was adjusted during the instillation of the medium in order to obtain uniform filling.

Reasons for incomplete visualization of the bronchial tree were as follows:

1. *Failure to use sufficient Dionosil.* If complete filling is not obtained with the 20 c.c. of Dionosil supplied in one bottle, a portion of a second bottle should be used. The extent of filling is best checked by observing the patient first on his side and then on his back, since in this latter position it is easier to determine if a portion of the posterior basal segment of the lower lobe or a portion of the apical segment of the upper lobe is incompletely filled.
2. *Improper preparation of Dionosil.* This medium is a suspension; it must be shaken thoroughly before use and must approximate body temperature. Otherwise it will remain in the major bronchi and not be dispersed satisfactorily by respiratory movement.
3. *Bronchospasm.* Patients with a history of asthma are particularly subject to bronchospasm. It may be so severe that the functioning segments are flooded immediately while the bronchi in other segments do not admit any of the medium. This may be remedied by the use of positive pressure inhalation of bronchodilators and bronchial detergents for several days before attempting re-examination. Cocaine is used as the local anesthetic for re-examination.
4. *Obstruction from secretions or tumor.* Bronchial branches that are diseased are more likely to contain secretions or granulation tissue and consequently are more difficult to fill than normal segments. Therefore, any segment which is incompletely filled should be viewed with suspicion, and repeated attempts should be

¹ From the University of Texas Medical Branch, Galveston, Texas. Accepted for publication in January 1958.

² Associate Professor of Radiology.

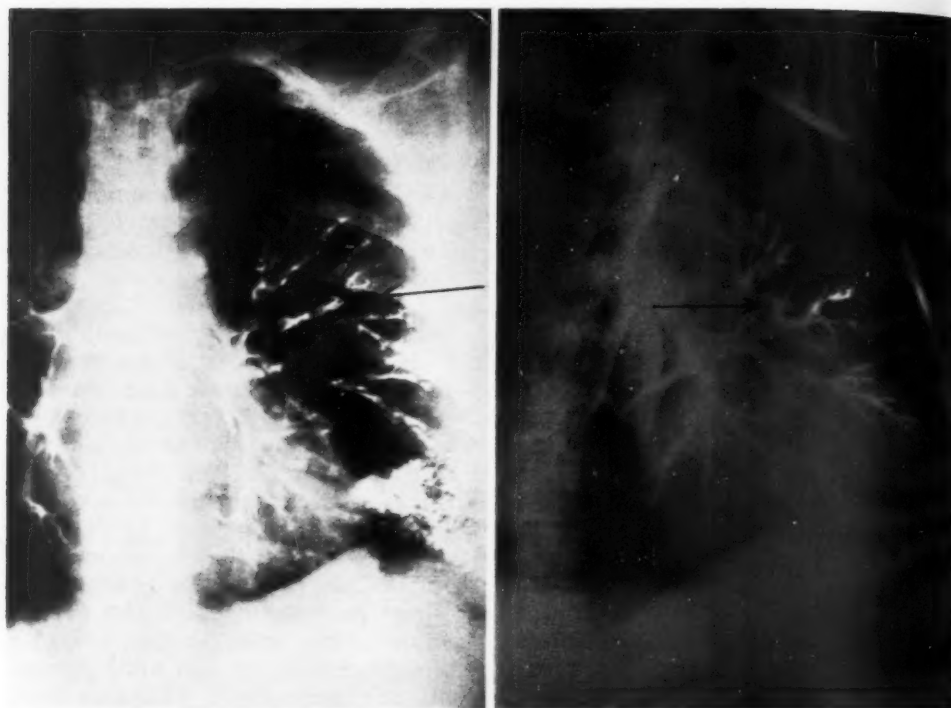


Fig. 1. Case I: Complete filling of the peripheral bronchi was not obtained because of bronchospasm and coughing. The arrow points to an unfilled diseased bronchus which can be seen on the re-examination (Fig. 2).

made to visualize it adequately. Postural drainage is advocated in all cases before bronchography, in order to clear the airways of secretions.

5. *Unsatisfactory anesthesia.*

CASE REPORTS

The following two cases illustrate the necessity for complete peripheral filling in a bronchogram.

CASE I: K. E., 48-year-old white female, was admitted with fever and cough. The general work-up revealed a hiatus hernia, which needed repair. Physical examination and laboratory data were non-contributory. No acid-fast organisms were found on sputum examinations. Bronchoscopy was negative.

Conventional chest roentgenograms were normal. A bronchogram was attempted, but because of bronchospasm and coughing there was incomplete peripheral filling (Fig. 1). A second attempt to examine the left side revealed a small area of localized bronchiectasis in a branch of the anterior segment of the left upper lobe (Fig. 2). The area was quite small but, since the hernia was to be repaired, it was

decided to resect a segment or lobe of the lung at the same time. The left upper lobe was removed and the bronchiectasis was found to be secondary to an active tuberculous lesion.

CASE II: A. B., 29-year-old white male, had had intermittent hemoptysis for eight years, producing as much as a cup of bright red blood at one time. He had no other symptoms. Physical examination and laboratory studies were non-contributory. Bronchoscopy was negative except for a small amount of secretion coming from both sides of the bronchial tree.

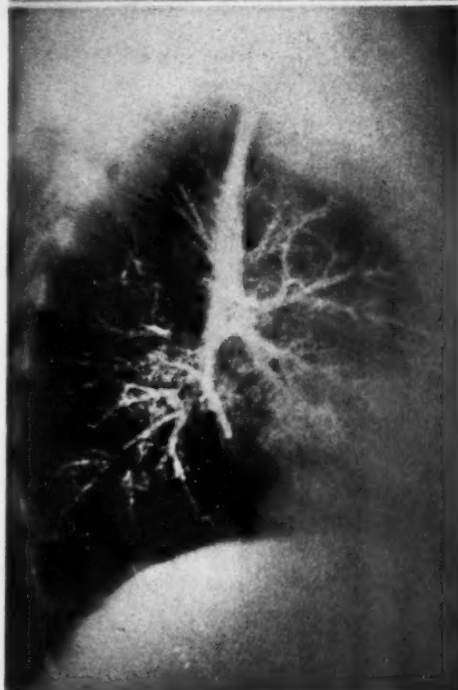
A chest film was normal. The first attempt at bronchography was unsuccessful because of spasm in the right lower lobe bronchi (Fig. 3). The examination was repeated, with selective filling of the right lower lobe, and two small peripheral branches of the lateral basal segment were shown to be bronchiectatic (Fig. 4).

Resection of this segment was performed and the diagnosis confirmed.

Comment: In both of these cases it was necessary to re-examine, as it was apparent that every bronchial branch was not identified on the first examination. Without



- 1. APICAL-POSTERIOR
- 2. ANTERIOR
- 3. ECTATIC BRANCH IN ANTERIOR SEGMENT
- 4. LINGULA



- 1. & 2. APICAL POSTERIOR
- 3. ECTATIC BRANCH IN ANTERIOR SEGMENT
- 4. ANTERIOR
- 5. LINGULA

Fig. 2. Case 1: Small branch of anterior segment now visualized and seen to be bronchiectatic.

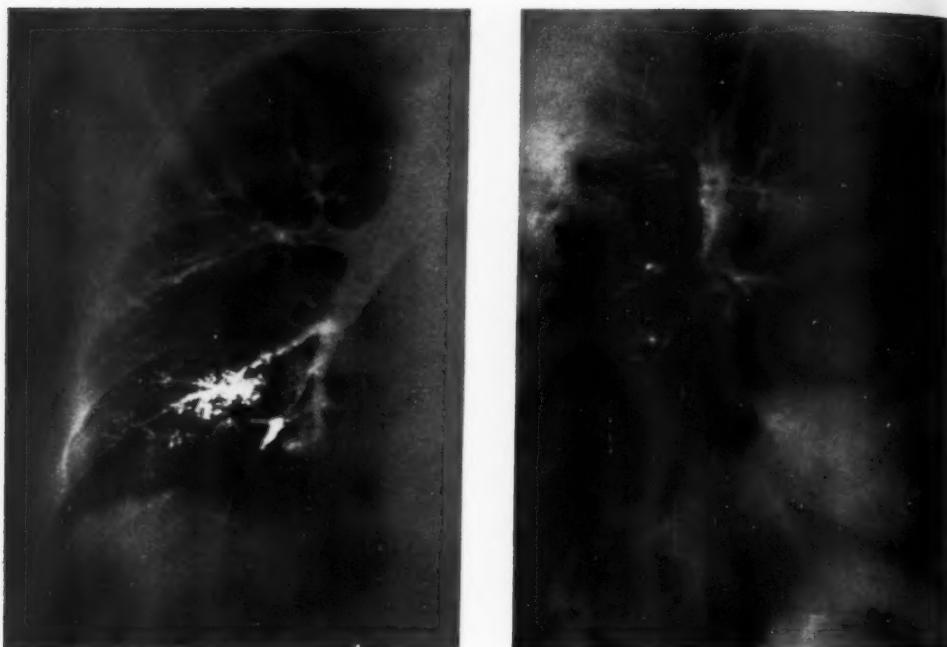


Fig. 3. Case II: Bronchospasm prevented complete peripheral filling of the lower lobe. Re-examination was requested.

complete peripheral filling, the lesions would not have been located for surgery.

REACTIONS

Reactions to Dionosil, particularly the aqueous preparation, have been described by a number of investigators (1-3). They occur with sufficient frequency to warrant further mention. Nearly one-half of the patients in whom the aqueous preparation was used displayed reactions, consisting either of a rather typical "flu-like" syndrome, with headache, mild fever, muscular aching, and malaise during the twenty-four hour period following examination, or symptoms of tracheobronchitis. In 2 patients urticaria developed before they left the X-ray Department. There has been less mention of the occurrence of respiratory distress at the time of injection of Dionosil. We have noticed this more frequently in patients with a history of asthma, emphysema, or previous thoracic surgery. Caution should be exerted in attempting simultaneous bilateral filling

in such cases. Respiratory distress may occur after filling of one lung, or of one remaining lobe in postoperative patients. In 1 patient, who had had the left lower lobe removed and a left phrenic crush, a pneumonia developed as a result of inability to evacuate aqueous Dionosil from the markedly distorted lingula. Fever, cough productive of purulent sputum, and hemoptysis persisted for one week following bronchography.

It will be noted that this institution reports a higher incidence of reactions to aqueous Dionosil than has been recorded from other sources. This is attributed to our close follow-up of the patients and to our emphasis upon complete peripheral bronchiolar filling which, as one would expect, results in more alveolar filling than might otherwise be observed. The reaction to aqueous Dionosil appears to be related to this latter feature. Since the reactions to oily Dionosil are few, we now prefer that medium and do not fear incidental filling of the alveoli.

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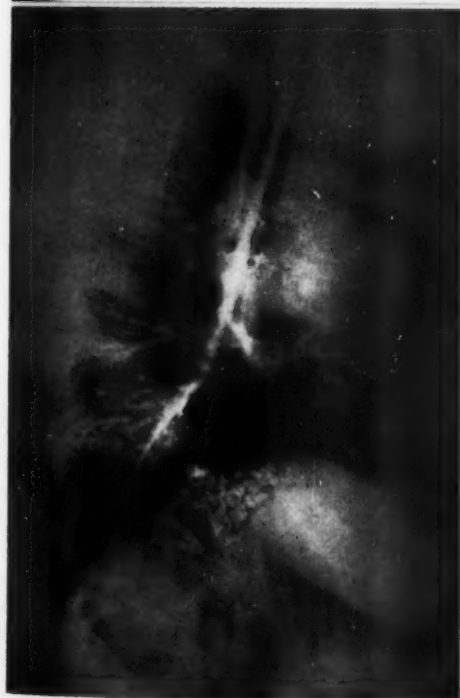
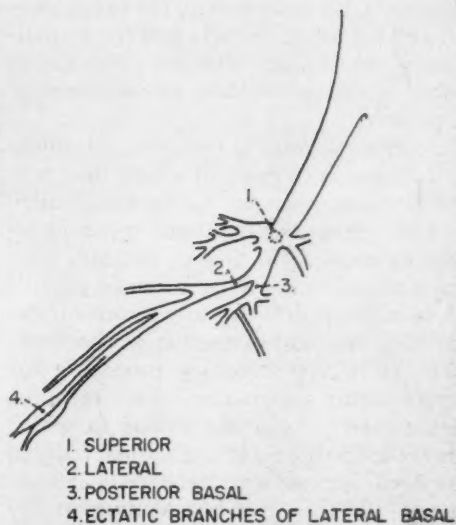


Fig. 4. Case II: Selective bronchography of right lower lobe revealed two dilated and diseased bronchi.

VALUE OF BRONCHOGRAPHY AND ITS INDICATIONS

In this series we have used bronchograms for three purposes: for establishing a diagnosis, for determining the exact location and extent of disease, and for visualization of morphologic changes which allows a more intelligent medical management of the patient.

The bronchogram is useful in establishing a diagnosis in cases in which the chest radiograph appears normal, in which there are undiagnosed infiltrations, spheroid lesions, or atelectasis, and in patients with symptoms following thoracic surgery.

A bronchogram is the only means for determining size and distortion of the bronchus. It is a satisfactory procedure for demonstrating obstruction, either intra- or extraluminal. Spheroid lesions in which filling could be obtained and normal bronchi were demonstrated were found to be inflammatory. If the bronchus leading to the area is blocked, the condition may be either inflammatory or neoplastic. It is desirable to know whether or not atelectasis is due to bronchial obstruction, either intra- or extraluminal. Open bronchi indicate disease in the lung parenchyma. In patients who continue to have symptoms after operation, a post-surgical bronchial stump may be demonstrated, there may be bronchiectasis in the remaining lobe or in additional areas of the lung, or distortion of the remaining lobe may result in poor function and drainage of the bronchi.

With the development and progress of thoracic surgery, more information is desired and the surgeon wishes to choose his operative approach either for pneumonectomy, lobectomy, or segmentectomy. Even in cases in which the diagnosis is already established, it is important to recognize the presence and extent of associated disease before thoracotomy. This applies to the study of spheroid lesions, lung abscesses, cysts, inactive tuberculosis, bronchiectasis, etc. In the presence of an intrathoracic mass, the bronchogram can define the exact limits of the lung tissue, indicating more exactly whether the mass is

TABLE I: FINAL DIAGNOSES IN 200 ABNORMAL BRONCHOGRAMS

1.	Bronchiectasis	86
2.	Tumor, malignant	14
3.	Tumor, benign	1
4.	Abscess	7
5.	Cyst	10
6.	Atelectasis, foreign body	6
7.	Atelectasis, parenchymal disease	12
8.	Bronchial stenosis	6
9.	Post-thoracoplasty	2
10.	Post-lobectomy	7
11.	Pleural disease	18
12.	Subdiaphragmatic abscess	2
13.	Emphysema	13
14.	Fibrosis	7
15.	Granuloma	1
16.	Sequestration	1
17.	Anomaly	6
18.	Pneumothorax	1

mediastinal, pleural, or in the lung parenchyma.

There is increasing interest in demonstrating morphologic changes present even when surgery is not anticipated, so that more intelligent medical management may be established. This applies particularly to postoperative thoracic surgery patients, patients with asthma or emphysema, and those with systemic diseases such as the collagen group. In some postlobectomy cases, for example, conventional postural drainage procedures may be totally inadequate because of a particular postoperative distortion of the remaining lobe which can be visualized only by means of bronchography.

Patients with asthma who are resistant to medical management are studied for associated bronchiectasis, which might be the source of bacterial allergy. A number of emphysematous patients are examined, particularly for the presence of a concomitant bronchiectasis.

There is a large group of systemic diseases in which the respiratory tract may bear the brunt of the damage. In infants and children, mucoviscidosis and agammaglobulinemia are the principal conditions in which bronchiectasis and atelectasis reflect the severity of respiratory tract involvement. In adults the ill defined group of systemic diseases which may be called collagen diseases, such as lupus erythematosus, scleroderma, dermatomyositis, rheumatoid arthritis, erythema nodosum, and

TABLE II: ADDITIONAL INFORMATION GAINED BY BRONCHOGRAPHY

Diagnosis by Chest Radiograph	No.	Diagnosis by Bronchography	No.	Final Diagnosis
Normal	173	Bronchiectasis	33	Same
Atelectasis	12	Bronchiectasis in other segments	8	Same
		Bronchial obstruction	6	Same
		Bronchi open	4	1 lupus erythematosus
		Carcinoma	2	Same
Mass	9	Carcinoma	4	Same
		Mediastinal mass	3	1 thymoma, 2 carcinoma
		Hilar mass, normal bronchi	1	Carcinoma
		Bronchial obstruction	1	No follow-up
Infiltration	23	Bronchiectasis	15	Same
		Inflammatory; normal bronchi	3	Same
		Carcinoma	1	Same
		Benign tumor	1	Chondroma
		Fibrosis, distorted bronchi	3	Same
Pleural disease	13	Bronchiectasis also	5	Same
		Obliterative pleuritis or fluid only	6	Same
		Atelectasis also	2	Same
Postoperative	2	Bronchiectasis	2	Same
Thoracoplasty	7	Bronchiectasis	3	Same
Lobectomy		Bronchial stump	3	Same
		Significant distortion	1	Same
Spheroid lesions	12	Bronchiectasis	3	Same
		Inflammatory; normal bronchi	4	1 error—carcinoma
		Pleural density	3	Same
		Cyst	1	Same
		Bronchial obstruction	1	No follow-up
Abscess	12	Bronchiectasis in other segments	9	Same
		Abscess only	2	1 sequestration
		Empyema only	1	Same
Cyst	6	Bronchiectasis in other segments	2	Same
		Cyst only	4	Same
Post-tuberculosis	8	Bronchiectasis	7	Same
		Atelectasis	1	Same

related diseases, are now being investigated. It is of interest to evaluate the morphologic changes that have taken place, particularly since the advent of steroid therapy in most of these cases.

INFORMATION GAINED BY BRONCHOGRAPHY

The 400 bronchographic examinations in this series were performed on approximately 277 patients. Not all had bilateral studies. Two hundred of these examinations were abnormal; 140 were normal; the remaining 60 were re-examinations. It should be pointed out that the 140 normal examinations were not useless, as there were definite indications in each instance, as a productive cough, hemoptysis, or some radiographic finding such as a spheroid lesion, an undiagnosed infiltration, etc. Demonstration of a normal bronchial tree indicated, in most cases, that these patients

could be treated medically instead of surgically.

Table I is a conventional type of report composed of final diagnoses in the 200 abnormal bronchograms. One may justifiably ask what information is actually gained by this examination that was not known from study of conventional radiographs. Table II was composed to answer this question and is a comparison of diagnoses as determined by chest radiographs and the additional information gained by bronchography, compared with the final diagnoses. It should be noted that the cases which may be grouped under tumor investigations (spheroid lesions, masses, and atelectases) do not represent the total number of cases of this type seen at John Sealy Hospital during the two-year period, but only those which could not be diagnosed by bronchoscopic examination and biopsy.

SUMMARY

The application of bronchography has greatly increased with the use of a rapidly absorbable medium. A review of 400 bronchograms obtained with Dionosil at John Sealy Hospital over a two-year period is given. Particular emphasis is placed on obtaining complete filling of the bronchial tree, including the peripheral bronchioles, since what cannot be seen cannot be diagnosed. Bronchography is useful for establishing a diagnosis, defining the exact location and extent of disease, and for enabling a more intelligent medical management of cases. The additional information

gained by bronchography over information already obtained from conventional chest roentgenograms is evaluated.

Medical Branch
University of Texas
Galveston, Texas

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SUMMARIO IN INTERLINGUA

Augmento Del Applicationes De Bronchographia Per Medio De Dionosil

Le uso de rapidamente absorbibile medios ha extendite grandemente le applicationes de bronchographia a morbos thoracic de varie typos. Le bronchogramma es utile in le establimento del diagnose, specialmente in casos in que le roentgenogramma thoracic rutinari es normal, pro determinar le sito exacte e le extension del morbo e pro demonstrar le occurrentia de alterationes morphologic (como base de plus intelligente decisiones in le programma chirurgic o medical).

Le autor usa Dionosil. Ille sublinea le importantia de effectuar un repletion complete del arbore bronchial, incluse le

bronchiolos peripheric, pro assecurar le optime resultados possibile. Un visualisation incomplete pote esser causate per un insufficientia quantitative del medio, per le incorrecte preparation de illo, per bronchospasmo, per obstruction in consequentia de secretiones o de un tumor, e per un inadequate anesthesia.

Inter 400 bronchogrammas obtenite con Dionosil ab 277 patientes al hospital John Sealy a Galveston in Texas, 200 esseva anormal. Istos esseva tabulate. Le resultante constataciones esseva comparate con le resultados de roentgenographia rutinari e con le diagnoses definitive.



Hydrocarbon Pneumonitis¹

FREDERICK J. BONTE, M.D., and JACK REYNOLDS, M.D.

IT HAS BEEN SAID that accidents account for one-third of all deaths in children and that one of the leading causes of accidental death in the very young is poisoning. Bain (1) has stated that 25 per cent of all poisonings in children under the age of five are due to the consumption of petroleum products. Of the petroleum oils, kerosene is responsible for the great majority of poisoning incidents, but a number of other hydrocarbons, both aliphatic and aromatic, have been ingested in the form of various items available in the average home, as furniture polish, lighter and cleaning fluid, insecticides, and similar materials.

Hydrocarbon poisoning is of considerable economic importance for, even though the mortality rate is low (of the order of 1 per cent), hospitalization is always required. This gains added significance when one considers that it is principally in the indigent household that kerosene is still used as a source of light and heat.

The pediatrician is familiar with the various clinical patterns displayed in hydrocarbon poisoning; these include all variations between the alert, asymptomatic patient and the vomiting, lethargic one, who may be febrile and exhibit obvious physical signs of pneumonic infiltration.

Management following hydrocarbon ingestion begins with gavage if there is good reason to believe that there is still unabsorbed material in the stomach. Further treatment includes the administration of oxygen and moist air, together with broad-spectrum antibiotic therapy. Other symptomatic and supportive measures are employed as needed. In general, response to this regime takes the form of rapid improvement but, if intake of the poisonous hydrocarbon has been massive, there may be residual central nervous system, pulmonary, or liver damage (2).

The finding of chief interest to radiologists is the rapid development of a pneumonitis of rather typical appearance, which may be appreciable on films made as early as twenty minutes after ingestion and may persist for weeks after symptoms have disappeared. The mechanism of production of this infiltrate has been a matter for lively discussion, and two theories still have many adherents (3-7). One possibility is that the development of an infiltrate is dependent principally upon aspiration of the toxic substance into the lungs, with or without vomiting. The second is that the substance is absorbed through the upper gastrointestinal tract and reaches the lungs blood-borne, there to cause an infiltration by a process of local irritation. A good deal of animal experimental work has been done on the etiology of hydrocarbon pneumonitis, much of it appearing to favor the aspiration school of thought.

CLINICAL MATERIAL

During the four-year period of this study (1952 through 1954 and 1956), 65 patients were observed in the emergency facility of Parkland Memorial Hospital (Dallas) because of ingestion of kerosene or other hydrocarbons. Five of these patients were not examined roentgenologically and have not been included in the series. The remaining 60 patients had at least one radiographic examination during their period of observation. Fifty-five of the 60 were admitted to the hospital for further care, the average length of hospital stay being four and a half days.

Of the 60 patients to be considered in this study 1 was a man of forty-four who attempted suicide. The remaining 59 were children ranging in age between thirteen and fifty months. The average child was approximately twenty months old and

¹ From the Departments of Radiology, Parkland Memorial Hospital and the University of Texas Southwestern Medical School, Dallas, Texas. Presented at the Forty-third Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 17-22, 1957.

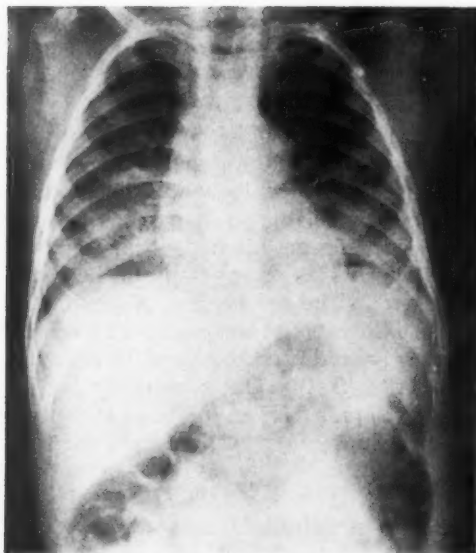


Fig. 1. L. G., 18-month-old Negro female, was admitted thirty minutes after the ingestion of an amount of kerosene estimated at 200 c.c. She became lethargic but did not vomit. On physical examination, râles and rhonchi were heard throughout both lung fields. The film made about one hour after ingestion shows well developed bilateral basal infiltrate. The clinical course was somewhat more indolent than usual, but the child was discharged, greatly improved, on the fifteenth day.

came from an indigent Negro household.

In 48 of the 60 cases, kerosene was the poisoning agent; in the remaining 12, other hydrocarbon products commonly to be found in the home were incriminated. Included in the latter category were house paint (1 case), gasoline (2 cases), turpentine (2 cases), lighter fluid (2 cases), several brands of furniture polishes and cleaners (3 cases), and insecticides (2 cases). Usually the amount of the toxic agent ingested was unknown and could not be estimated with any degree of certainty. As one might expect, there was a correlation between amount ingested and the severity of clinical symptoms, as well as the amount of visible infiltrate on x-ray films and the duration of hospitalization required.

A history of spontaneous or induced vomiting could be obtained in about one-third of all cases, but an analysis of our material shows no real correlation between a history of vomiting and the extent of the

disease. If hydrocarbon pneumonitis is due to aspiration, this process must occur at the time of ingestion. Obviously it cannot be dependent upon the mechanism of vomiting, if the histories elicited in our cases were correct.

Physical examination revealed signs consistent with the presence of pulmonary consolidation in but 40 per cent of the cases, whereas radiographically demonstrable infiltrates were present in almost all of them.

During the earlier years of the period of this study it was customary to treat virtually all cases of hydrocarbon poisoning with gavage, but this does not appear to affect the extent of the disease radiographically, or to lessen the average length of hospital stay. In the past, gavage has been blamed for the development of the infiltrate, but this does not seem to have been substantiated in our material.

RADIOGRAPHIC APPEARANCE

Table I shows a classification of radiographic findings on initial chest films of the 60 patients in this series. We have em-

TABLE I: DISTRIBUTION OF 60 CASES OF HYDROCARBON PNEUMONITIS BY RADIOGRAPHIC APPEARANCE

Extent of Disease	Number	Per Cent
No infiltrate	4	6.7
Equivocal	4	6.7
Group 1	27	45.0
Group 2	22	37.0
Group 3	3	5.0

ployed Foley's (4) classification by size of infiltrate on the postero-anterior film, which is as follows: Group 1, less than 10 per cent of the lung area involved; Group 2, more than 10 but less than 30 per cent of the lung area; Group 3, more than 30 per cent of the lung area. It can be seen that the majority of cases fall into Groups 1 and 2. Three of the cases showed extensive infiltrates. Four showed minimal or questionable infiltrative processes, while the remaining 4 cases showed no evidence of an infiltrate on one or more chest examinations. The infiltrates ranged in character from softly flocculent to homogeneous.

Three typical distributions could be seen.

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Fig. 2. G. B., 22-month-old Negro female, was admitted about one hour after ingestion of an unknown quantity of kerosene. There was no history of vomiting. The patient was lethargic and showed clinical evidence of pulmonary consolidation in the right base. A. Film made shortly after admission, showing an extensive infiltrate on the right. A lesser infiltrate may be present on the left behind the heart. The predominant right basal infiltrate is a not uncommon expression of hydrocarbon pneumonitis. B. Persistent visible infiltrate after twelve days.

The most common of these was the bilateral basal, as illustrated in Figure 1. This distribution was encountered in 38 of 60 cases. The least common location was in the right base only (Fig. 2). This appearance was present in 8 of 60 cases, though, in not a few of these, relatively minor infiltrates might have been hidden behind the heart in the postero-anterior view. In general, the distribution of the infiltrates in these two patterns, with the lower lobes principally involved, favors the concept of an aspiration process. With the exception of the lingular portion of the left upper lobe, upper lobe involvement was not seen. The third manifestation of hydrocarbon pneumonitis was the pattern of perihilar infiltrate and clear bases, suggesting an interstitial process. This has been referred to as the "edema" type, and was encountered in 10 of our 60 cases (Fig. 3.).

Characteristically, resolution of the radiographically recognizable infiltrate lags well behind clinical improvement. Figure

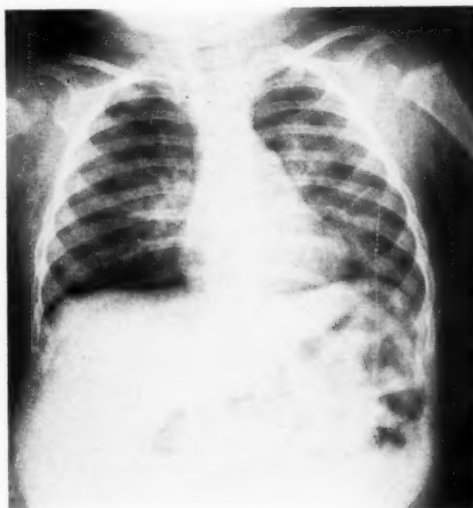


Fig. 3. L. C., 16-month-old white female, was admitted about two hours after the ingestion of an unknown amount of lighter fluid. She was asymptomatic and had not vomited. There were no positive physical findings. An admission postero-anterior film shows the bilateral symmetrical infiltrates of the interstitial type, resembling pulmonary edema. This is the least common expression of hydrocarbon pneumonitis.

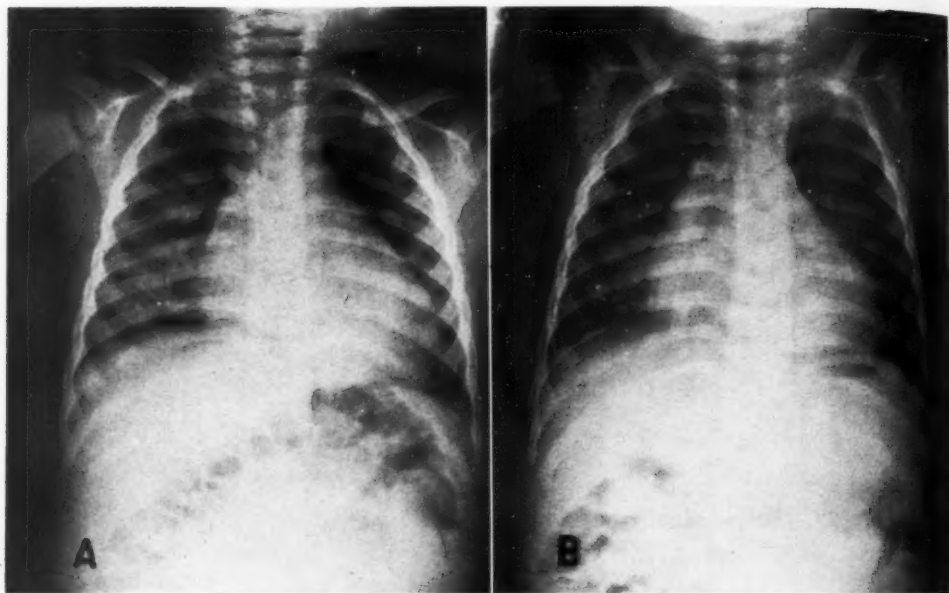


Fig. 4. D. L., 15-month-old Negro male, was admitted about one hour after ingestion of an unknown amount of insecticide containing 98 per cent petroleum distillates and 2 per cent chlordane. A. Admission film showing rather extensive infiltrate, primarily of the interstitial type. B. Film made twenty-four hours later, showing clearing to be somewhat more rapid than is usual in hydrocarbon pneumonitis. There was no evidence of residual liver damage due to chlordane ingestion.

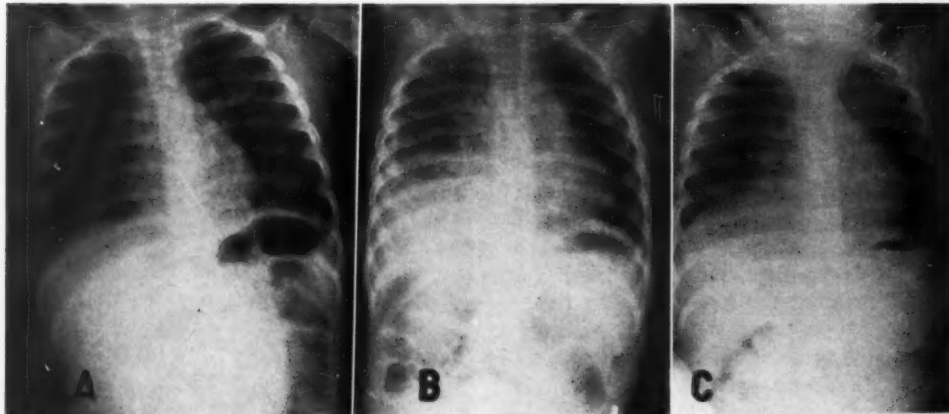


Fig. 5. M. W., 16-month-old white female, was admitted within twenty minutes after ingestion of about 100 c.c. of an insecticide. A. Film obtained immediately, approximately twenty minutes after ingestion, shows early minimal infiltrates in the medial aspects of both bases. B. Film showing development of a more extensive infiltrate and a pleural effusion; this is a rare event in the course of hydrocarbon pneumonitis and may be the result of secondary infection. C. Film made twelve days after admission, showing clearing as yet incomplete. Effusion has disappeared.

The insecticide, the same as that taken by D. L. (Fig. 4), contained petroleum distillates (98 per cent) and chlordane (2 per cent). Despite the history of ingestion of a large amount of the chlordane in this case, there was no evidence of residual liver damage.

2 represents a typical uncomplicated case in which there is a persistent visible infiltrate at twelve days. Figure 4, on the

other hand, shows that occasionally an infiltrate can resolve very rapidly.

In a few of the cases the clinical course

was unfavorable and recovery was not rapid. Such a case is illustrated in Figure 5. In this patient an initially small infiltrate later became much more extensive, and a pleural effusion developed. This occurred in only one other case in the series, and on both occasions it was the opinion of pediatricians that a secondary infection had occurred. As shown in Figure 5, clearing remained incomplete at twelve days, although the pleural effusion had subsided. A minor degree of atelectasis may yet be present in the lower lobe on the final film.

As one might expect, it is impossible to distinguish between the various hydrocarbon poisons on the basis of the appearance of the pulmonary infiltrates they produce. In this series, for example, Figures 1 and 2 represent cases of kerosene ingestion. The "edema" type of infiltrate illustrated in Figure 3 was caused by the ingestion of lighter fluid. The other case of lighter fluid poisoning in our series showed bilateral basal infiltrates. The infiltrates in Figures 4 and 5 were produced by ingestion of the same brand of insecticide. Figure 6 shows a minimal infiltrate detected after



Fig. 6. M. L., 21-month-old Negro female, was admitted thirty minutes after ingestion of an unknown quantity of house paint. She had become progressively lethargic and had vomited. Clinically there were signs of pneumonic infiltration in the right lower lobe. A minimal infiltrate is seen in the medial aspect of the right base.

the ingestion of house paint. Figure 7 illustrates lower lobe infiltration (more readily appreciable on the lateral film) in

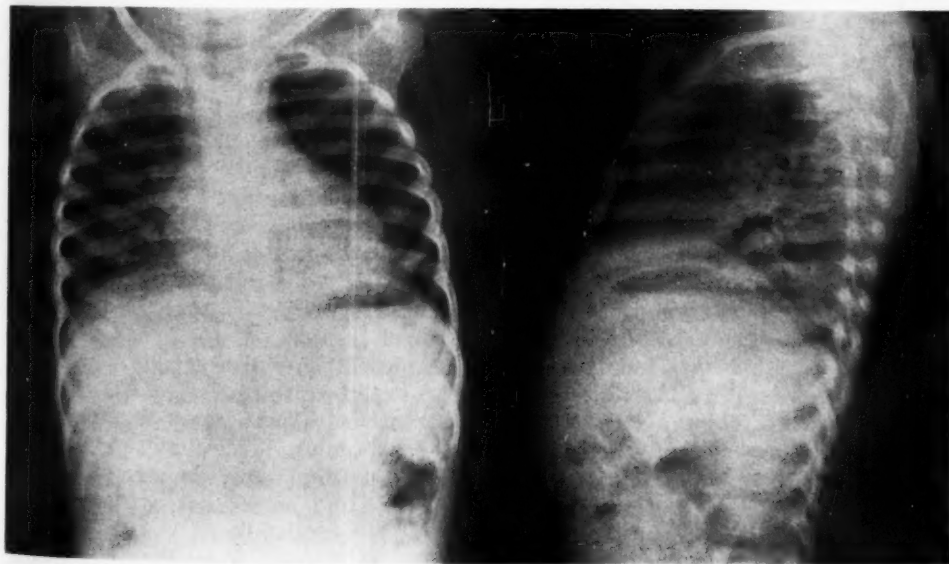


Fig. 7. D. D., 22-month-old Negro female, was admitted two hours after the ingestion of an unknown amount of cleaning fluid. Clinically the lungs were clear and the patient had not vomited. Films show bilateral basal infiltrates confined principally to the lower lobes.

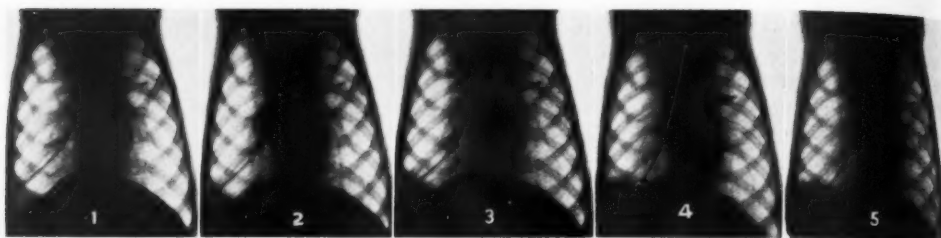


Fig. 8. Representative frames from a time-lapse cineroentgenogram of the dog's lung. Frame 1 represents initial density in the right costophrenic angle caused by injection of 15 c.c. of kerosene. Frame 2, at twenty minutes, shows initial pneumonic infiltrate surrounding the area of deposition of kerosene. In Frame 3, at thirty minutes, a well developed infiltrate is seen in the costophrenic angle. In Frame 4, at fifty minutes, the process has extended along the diaphragm medially. Frame 5, made at two hours, shows further progression of the infiltrate. An equal volume of normal saline was injected through left catheter as control.

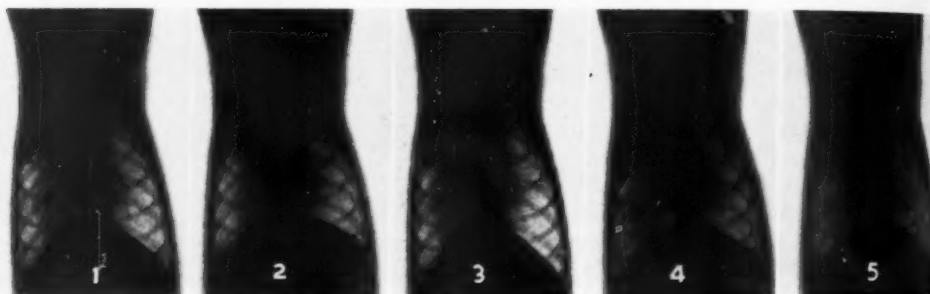


Fig. 9. Selected frames from time-lapse cineroentgenogram after the injection of 12 c.c. of kerosene through a catheter inserted into the right upper lobe bronchus. Frame 1 shows density in the base of the right upper lobe immediately following deposition of kerosene; Frame 2 made at fifteen minutes, early development of the infiltrate; Frame 3, at fifty minutes, a well developed infiltrate involving the inferior half of the right upper lobe. Frames 4 and 5, made at one and a half and two hours, respectively, show extension of the process to involve almost the entire upper lobe.

a child who had swallowed an unknown amount of a cleaning compound.

CLINICAL COURSE

There was no fatality in this group, and among those cases followed there was only 1 instance of sequelae of a severe nature which might be blamed on the episode of hydrocarbon intoxication.

EXPERIMENTAL STUDIES

While this case material was being collected, it was noted that films had been obtained in several instances within a relatively short time after ingestion of the toxic material. In one instance the interval could be reliably estimated as a maximum of twenty minutes. The initial film is shown in Figure 5, and it can be seen that there was a readily appreciable infiltrate present at that time. The authors decided to determine experimentally the

minimum interval at which an infiltrate could be detected, and to depict the rate of development of pneumonic consolidation following the deposition of kerosene in the lung of an experimental animal.

The radiographic apparatus employed is constructed according to the Ramsey principle and permits cinefluorographic exposures at the rate of $3\frac{3}{4}$ to 30 frames per second. By obtaining a number of frames at arbitrary intervals after the administration of kerosene, it was hoped that time-lapse roentgen movies could be made. In this experiment dogs weighing 20 kg. were employed. Tracheotomy was performed under Nembutal anesthesia, and No. 15 woven ureteral catheters were passed into the right and left main-stem bronchi under fluoroscopic control.

Figure 8 shows selected frames from a time-lapse cineroentgenogram made after the instillation of 15 c.c. of kerosene through

the catheter into the right lung. A measure of density control was attempted by instilling an equal amount of normal saline through the catheter into the left lung. It will be noted that a definitely visible infiltrate is present at fifteen to twenty minutes and that the process grows steadily in size until the death of the animal at three hours. Figure 9 shows another experiment of this same nature, with a different placement of the catheter on the right. Properly edited, the films from which the above strips are taken form a smoothly continuous picture of the development and growth of the infiltrative lesion, suggesting that time-lapse cinefluorography might constitute an interesting addition to the teacher's portfolio. The development of lesions of other sorts can be shown in this manner.

SUMMARY AND CONCLUSIONS

1. The ingestion of hydrocarbons commonly found about the home is a leading cause of poisoning in children. It almost always results in the development of a pneumonitis visible roentgenographically a very short time after the material has been consumed. Clinically the outcome is almost always favorable. There was no fatality in the series of 65 cases reviewed here.

SUMMARY IN INTERLINGUA Pneumonitis A Hydrocarburo

Es reportate un serie de 65 casos de intoxication per hydrocarburo, resultante del ingestion de kerosen, oleo de polir, essentia pro incende-cigarretas, fluido de nitidage, insecticidas, e altere preparatos que se trova communmente in le domicilio. Con le exception de 1 pretendite suicida, omne le patientes esseva juveniles. Le condition es characterisate per le disveloppamento rapide de un pneumonitis de apparentia satis typic que es demonstrabile a vices jam vinti minutas post le ingestion del veneno e pote persiste durante plure septimanas post le restablimento clinic.

Le infiltratos es classificate secundo lor

2. The common appearance and distribution of pneumonitis caused by ingestion of various hydrocarbons has been shown.

3. Hydrocarbon pneumonitis has been produced experimentally in dogs and the development of the process has been depicted by means of time-lapse cinefluorography. This technic shows promise as an aid in the teaching of diagnostic radiology.

5201 Harry Hines Blvd.
Dallas 19, Texas

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extension. In le presente serie, le majoritate afficeva minus que 30 pro cento del area pulmonar. Le distribution le plus commun esseva bilateral basal, le plus rar esseva dextero-basal solmente. Un gruppo intermediari de casos monstrava infiltration perihilar a base clar, i.e. le si-appellate "typo edematic." Le curso es quasi sempre favorable.

Pro observar le disveloppamento de pneumonitis causate per hydrocarburo, studios cineroentgenographic a retardo de tempore esseva executate in canes post le introduction de kerosen a in lor pulmones. Iste technica es recommendate como adjuta docential.

Pulmonary Torulosis¹

LEWIS G. JACOBS, M.D.

PULMONARY torulosis as a cause for an asymptomatic solitary nodule in the lung has been given little attention. The increasing frequency of excision of such nodules to exclude cancer has led to a microscopic diagnosis of torulosis in 8 instances during the last ten years at the VA Hospital in Oakland (Calif.), which suggests that a solitary nodule is a more common syndrome than the better recognized types of *Torula* infection.

Infection with *Torula* or *Cryptococcus neoformans*, as presented in the literature, is considered highly fatal, because in most reported cases the patient has been seen in the acute stage of the disease, with

generalized torulosis, *Torula* meningitis, pneumonic or granulomatous torulosis of the lung or a combination of these lesions. In such cases, there is no really satisfactory form of treatment. The known antibiotics are ineffective, while the evidence on sulfa drugs is somewhat contradictory, some reports indicating a favorable response to sulfadiazine. Resectional therapy has enjoyed some success for localized pulmonary lesions. Prolonged spontaneous remission may occur, but even in such cases the mortality rate approximates 60 per cent.

Multiple inactive pulmonary granulomas have also been recognized as a result

TABLE I: CLINICAL DATA FOR TEN CASES OF PULMONARY TORULOSIS

Case No.	Age	Clinical Picture	Type of Lesion	Operation	Culture†	Spinal Tap	Complication	Results
1	30	Repeated bouts of acute pneumonia	Pneumonic left upper lobe	Lobectomy	No growth	Not done	....	Well 11 months
2	39	Acute pneumonia following exposure to prune rot; second attack 4 months later	Mass lesion in right upper lobe	Lobectomy	<i>Torula</i> ; <i>Candida albicans</i> *	Normal	....	Well 22 months
3	22	Routine chest film (Navy)	Nodule in left upper lobe	Wedge resection	<i>Candida albicans</i> *	Not done	....	Well 48 months
4	40	"Chest cold"	Nodule in left lower lobe	Wedge resection	No growth	Not done	....	Well 26 months
5	54	Chest pain, exertional dyspnea, 1 year	Nodule in left lower lobe	Wedge resection	No growth	Normal	....	Well 17 months
6	37	Routine chest film (mobile wagon)	Nodule in right lower lobe	Wedge resection	Not done	Normal	....	Well 22 months
7	41	Routine chest film (admission to hosp.)	Nodule in right lower lobe	Wedge resection	No growth	Normal	Duodenal ulcer	Well 19 months
8	62	Routine chest film (for admission to soldiers' home)	Nodule in left upper lobe	Wedge resection	No growth	Normal	Hiatus hernia	Well 7 months
9	26	Routine chest film (Navy)	Nodule in right lower lobe	Wedge resection	No growth	Normal	....	Well 35 months
10	46	Routine chest film (for employment)	Nodule in left upper lobe	Wedge resection	No growth	Not done	Tuberculosis†	Well 30 months

* *Candida* is considered a contaminant.

† Guinea pig inoculated with tissue from granuloma positive for tuberculosis.

‡ Culture of tissue removed at operation.

¹ From Veterans Administration Hospital, Oakland, Calif. Presented at the Forty-third Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 17-22, 1957.

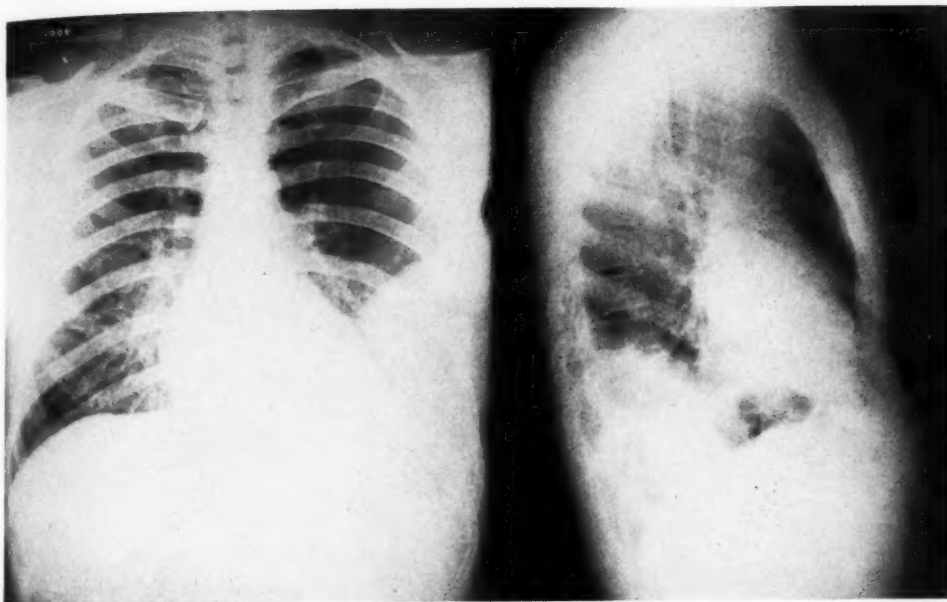


Fig. 1. Case 1. Pneumonic torulosis (see Table I). Postero-anterior and lateral views of chest on entry, showing pneumonic changes in lingula and left upper lobe, with posterior encapsulation.

of *Torula* infection. Zinsser's *Textbook of Bacteriology* (8) states: "It is probable that mild infections of the skin and lungs occur without being recognized and spontaneous cures take place." No specific instances are recorded, however. Bonmati, *et al.* (3) have summarized the prevailing ideas concerning this infection and mention the possibility of "healing" by fibrosis but, like most essayists, have not appreciated that torulosis of the lung is usually a benign infection leading to the production of an inactive granuloma resembling a tuberculoma clinically, radiologically, and pathologically. The significant finding in these granulomas is the organism itself, although it generally appears impossible to obtain cultures from these "healed" lesions.

Although some essayists have postulated that the primary site of *Torula* infection is the lung, reports of infection limited to the lung are uncommon. Perhaps the most revealing is that of Haugen and Baker (6), whose 15 cases included 9 granulomas, 4 of which were found incidentally at necropsy. Monnet and Blanc

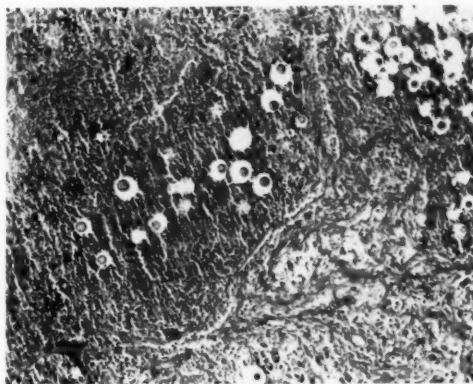


Fig. 2. Case 1. Pneumonic torulosis. Photomicrograph of material removed at operation. $\times 60$.

(7) also noted the common incidence of gelatinous or caseous granulomas, but seem to have insufficiently appreciated the frequency of solitary healed nodules. Central nervous system involvement has been present in a very high percentage of reported cases, with pulmonary involvement a relatively minor complication. Carton and Mount (4), for example, estimated that the central nervous system

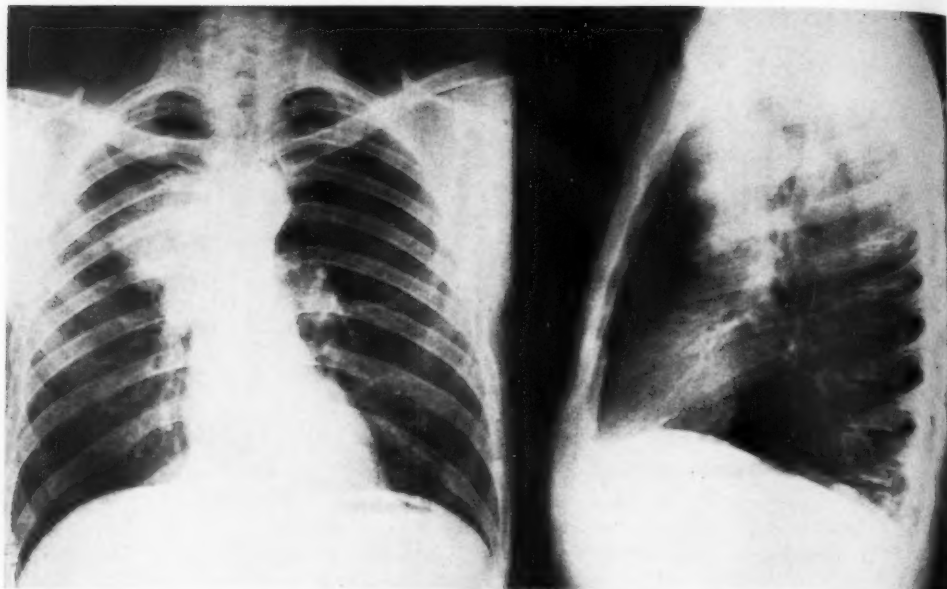


Fig. 3. Case 2. Granulomatous torulosis (see Table I). Postero-anterior and lateral views of chest on entry, showing parahilar mass lesion resembling a central carcinoma.

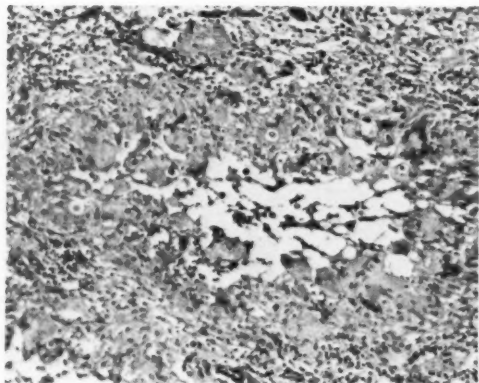


Fig. 4. Case 2. Photomicrograph of material removed at operation. $\times 70$.

is involved in 81 per cent of cases, with disease of the lung in 20 per cent of these. As Haugen and Baker recognized, this is a rather gross overestimate of the frequency of torulosis of the central nervous system. Our series of 10 cases (all cases of torulosis of any form seen at this hospital) includes 8 with a solitary granulomatous nodule, which, as mentioned earlier, suggests that the solitary healed nodule is

the most common clinical form of pulmonary torulosis. The rarity of diagnosis is merely an expression of the absence of significant clinical symptoms. All of our cases were diagnosed following excision of the lesion to exclude suspected cancer; 6 were first encountered on routine chest films of persons with no chest symptoms; another patient had only a "chest cold," probably unrelated to his *Torula* infection.

Table I summarizes our material. All patients were white males, there being only a few females at this hospital. The absence of Negroes and orientals is not clearly explained, since a fairly high percentage of both are seen here. Case 1 was previously reported by Berk and Gerstl (2) and is included with their kind permission for the sake of completeness. The illustrations represent the typical findings in the series, namely, pneumonic consolidation, mass granuloma, and a small solitary nodule. They are from Cases 1, 2, and 4 of the Table.

The histopathological findings depend on the stage of the lesion. In pneumonic

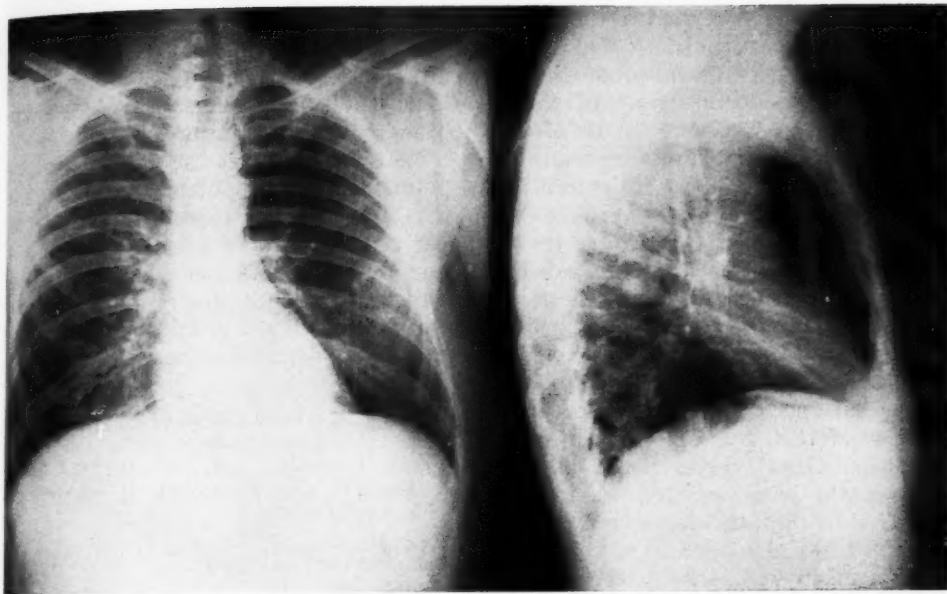


Fig. 5. Case 4. "Caseous" granuloma due to torulosis (see Table I). Postero-anterior and lateral views of chest showing solitary nodule in superior segment of left lower lobe.

torulosis there is extensive central necrosis. Many organisms are present; some are extracellular (Fig. 2) forming masses of gelatinous material in which they are embedded, while others are engulfed in multinucleated giant cells. The cellular exudate is of a mixed polymorphonuclear and lymphocytic character. Alveolar septa may be preserved. In the acute granulomatous lesions (Fig. 4) many ovoid organisms, about 15 microns in diameter, showing a wide, pale staining capsule with a dark staining round center are found; the staining characteristics are particularly well demonstrated by the periodic acid-Schiff (PAS) stain. Differentiation of the granuloma of torulosis from those of other mycotic infections and of tuberculosis depends on the presence of the organisms, the absence of epithelioid cells, and the peripheral connective tissue proliferation. The late stage of the granuloma, seen in 8 of our cases, shows a "caseous" necrotic center surrounded by moderately well developed connective tissue in which groups of lymphocytes and occasional giant cells and plasma cells are seen (Fig. 6). In sec-

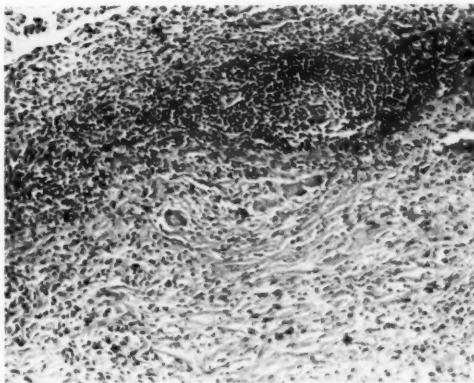


Fig. 6. Case 9. Caseous granuloma due to torulosis (see Table I). Photomicrograph of material removed at operation, showing typical finding described in text. $\times 70$.

tions stained with hematoxylin-eosin only a suggestion of the spherule-like organisms can be seen, but organisms can usually be demonstrated by employing the PAS stain. The histopathology of our cases is similar to that described by Baker and Haugen (1).

The active lesions sometimes yield positive cultures; the healed lesions rarely,

The finding appears related to the state of activity of the organism. This inconsistency of positive cultural proof of necessity throws doubt on many of the reported cases, as well as on most of ours, but it seems reasonable to accept morphologic identification, since this has been commonly done by other essayists. However, our Case 10 well illustrates the difficulty of the matter and is included for that reason. In this instance, the microscopic pathology was considered typical of torulosis and so reported, but guinea-pig inoculation of the material led to a recovery of pathogenic tubercle bacilli. In view of this, the Chief of Pathology, Dr. Bruno Gerstl, reviewed the slides and reversed the initial opinion, stating: "It is probable that the lesion represents a combined infection with an atypical acid-fast organism with a nonpathogenic fungus." This in turn leads one to wonder about the validity of all morphologic diagnoses. On the other hand, one might equally well wonder about the reversal of opinion, since the coincidence of torulosis with tuberculosis has previously been reported by Corpe and Parr (5). In choosing to accept morphologic proof, it is our belief that the concept of torulosis presented here is a valid one and the waiving of strict scientific evidence is warranted because of the clinical importance of recognizing this situation.

SUMMARY

A modified concept of torulosis of the lung is presented as a result of review of 10 cases. The disease is pictured as a generally benign infection healing by formation of a fibrocaseous nodule in which

organisms morphologically typical of *Torula* are found on microscopic examination, but cannot be cultured, being presumably inactive or dead. This type of lesion appears to represent the majority of cases.

Certain active cases with progressive pulmonary or extrapulmonary lesions have a relatively great mortality, possibly 60 per cent. In those cases limited to the lung, cure by resection may be obtained, but most patients with meningeal or generalized lesions die in spite of any form of therapy known at the present time.

ACKNOWLEDGMENTS: The assistance of Dr. Bruno Gerstl in evaluating the pathological material and preparing the photomicrographs, and of Miss Maude Greenwood and Mr. Hal M. Strong in preparing the illustrations, is acknowledged with deep gratitude.

VA Hospital
Thirteenth and Harrison Sts.
Oakland, Calif.

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SUMMARIO IN INTERLINGUA

Torulosis Pulmonar

Es presentate un modificate conception de torulosis pulmonar, resultante del revista de 10 casos. Le morbo es portraite como un generalmente benigne infection que se resana per le formation de

nodulos fibrocaseose in le quales es incontrate organismos que es morphologicamente typic de *Torula* in le examine microscopic sed que non pote esser cultivate, probabilemente proque illos es inactive

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o morte. Iste typo de lesion representa
apparentemente le majoritate del casos.
Omne le casos del autor esseva diagno-
sticate post excision del lesion pro excluder
le suspicion de cancro. Septe casos esseva
notate originalmente in roentgenogrammas
routinari del thorace de individuos sin
symptomas thoracic.

Un certe typo de casos active con pro-

gressive lesiones pulmonar o extrapulmonar
se distingue per un relativamente alte
mortalitate, amontante possibilmente a
60 pro cento. In casos restringite al
pulmon, curation es possibile per resection,
sed le majoritate del pacientes con lesiones
meningee o generalisate mori in despecto
de omne forma de therapia que es nunc
cognoscite.



Peripelvic Cysts of the Kidney

WILLIAM DUBILIER, JR., M.D., and JOHN A. EVANS, M.D.

PERIPELVIC cysts of the kidney may be defined as cysts which are situated in the hilus of the kidney, intimately associated with the renal pelvis and calyces. They may be simple or multiloculated, single or multiple. Unlike the common simple cysts of the kidney parenchyma, peripelvic cysts are not buried within the renal parenchyma nor are they present as a mass in either pole or along the external surface of the kidney. Instead, they compress and displace the renal pelvis and vascular pedicle. If large enough, they may protrude from the renal hilus.

Peripelvic cysts which are large enough to cause symptoms or be detectable on radiographs are rare and have been seldom reported in the urological or radiological

literature. Smaller multiloculated hilar cysts, however, which are not detectable *in vivo* are not unusual, being said to occur in over 1 per cent of routine autopsies (1). Henthorne (3) found 20 cases of peripelvic cysts at autopsy. These varied in size from microscopic to 5 cm. in diameter. Scholl (6) described 2 cysts of sufficient size to cause distortion of the renal pelvis on the urogram. Both of these exerted pressure on the structures of the renal hilus and were apparently related to significant hypertension. Only a few additional reports of large peripelvic cysts are to be found in the literature (2, 4, 5). Analysis of a large series of renal masses studied by nephrotomography in the New York Hospital-Cornell Medical Center



Fig. 1. A 50-year-old patient was examined because of hematuria. Intravenous (A) and retrograde (B) pyelograms reveal a large right hilar mass compressing and displacing the right renal pelvis. There are masses also in the left hilus, with an extrinsic pressure defect of the renal pelvis and elongation of the calyces. Exploration of the right kidney demonstrated a large cyst protruding from the hilus like a balloon and several smaller cysts deeper in the hilus. The vascular pedicle and renal pelvis were stretched over the cyst. The left kidney was not explored. It was felt that the hematuria was probably due to chronic pyelonephritis.

¹ From the Department of Radiology, The New York Hospital-Cornell Medical Center, New York, N. Y. Accepted for publication in February 1958.

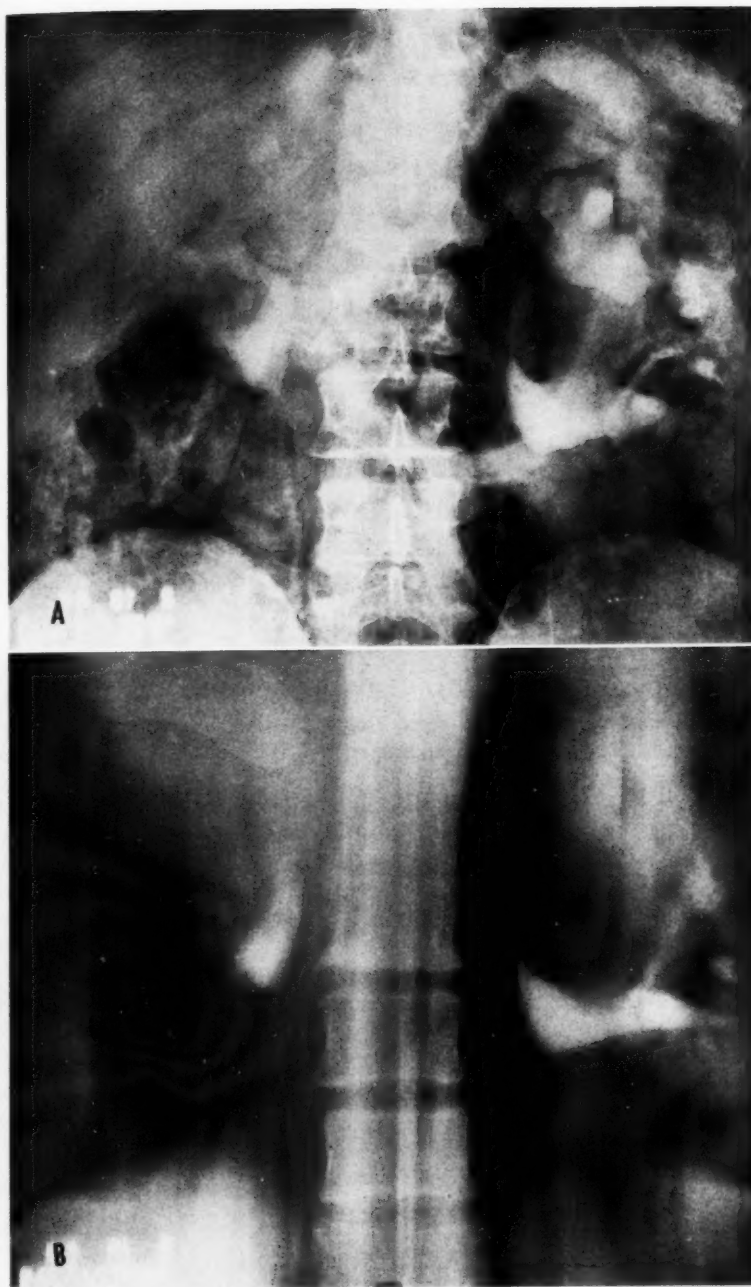


Fig. 2. Hypertensive patient whose intravenous pyelogram (A) reveals compression and displacement of the left renal pelvis due to a hilar mass. There is considerable caliectasis due to partial obstruction of the infundibula. The nephrotomogram (B) demonstrates relative radiolucency of the hilar mass, which is spreading the calyces and compressing the pelvis. Surgical exploration demonstrated multiple large peripelvic cysts containing clear fluid. Following extirpation of the cysts, there was no change in the blood pressure.

during the last four years yields a total of 117 simple cysts of the renal parenchyma. In this same series there are only 7 masses with the appearance of peripelvic hilar cysts. This indicates their relative rarity.

The pathogenesis of these cysts is obscure. They probably originate in the hilus of the kidney rather than from the adjacent renal parenchyma or from the renal pelvis. Henthorne believes that they are lymphatic cysts which may have developed in areas of lymphatic ectasia due to chronic inflammatory changes. Other authors suggest that they are congenital cysts arising from embryonic rests. Allen (1) suggests an origin from remnants of the wolffian body. Haslinger (2) believes that they may have developed from mesonephric remnants.

CLINICAL MATERIAL

We have collected a total of 13 cases of renal hilar masses demonstrated by pyelography in recent years. It was originally believed that all of these were cysts. Subsequent surgical exploration has proved 7 to be peripelvic cysts, while 2 were found to be lipomas of the renal hilus, believed to represent hypertrophy of the peripelvic fat. The remaining 4 cases have not been explored.

Three of the proved cysts distorted the renal pelvis enough to cause partial obstruction and caliectasis. In one of these cases there was an associated pyelonephritis with symptoms. In none of the other cases were there symptoms which could be produced by the cysts. The renal masses appeared as incidental findings on urographic examinations which were done for unassociated conditions. None of these patients had hypertension which could be attributed to interference with the renal vessels in the hilus.

On surgical exploration, all of the cysts had a similar appearance. They varied from 5 to 10 cm. in diameter. In every instance there were several small cysts as well as one or more large cysts. The larger cysts protruded from the hilus; the smaller ones were deep in the hilus,

adjacent to the calyces. All were bluish, lucent, thin-walled structures containing yellowish fluid. In every case the cysts were partially excised or enucleated and the kidney was not removed. The cyst walls consisted of fibrous tissue with a flattened epithelial cell lining.

RADIOGRAPHIC FINDINGS

All the peripelvic cysts have exhibited similar bizarre radiographic characteristics. In excretory or retrograde pyelograms there is evidence of a soft-tissue mass in the renal hilus, with compression and displacement of the kidney pelvis. In several cases there is evidence of masses about the central portions of the calyces, with compression and separation of the major infundibula (Fig. 1). There may be mild degrees of caliectasis due to the poor drainage of the compressed pelvis and infundibula (Fig. 2). No calcification of the cyst wall was detectable in any instance. Several of the patients were examined by nephrotomography. This only demonstrated that the mass contained no vessels, suggesting that it was not a carcinoma. Unlike simple cysts of the kidney, peripelvic cysts are not surrounded by opacified renal parenchyma. Therefore they do not have the typical sharply margined radiolucent appearance of a parenchymal cyst on a nephrotomogram.

The 2 patients who proved to have lipomas of the renal hilus at surgery exhibited the same distortion of the renal pelvis. No definite fatty radiolucency could be seen in the region of the hilar mass in their pyelograms, and their appearance on a nephrotomogram was identical to that of a cyst (Fig. 3).

DISCUSSION AND CONCLUSIONS

Peripelvic cysts are uncommon renal masses. Their presence should be suspected when there is a bizarre distortion of the renal pelvis. However, a lipoma may cause the same appearance on the pyelogram. The mass may compress the renal pelvis enough to cause caliectasis and pyelonephritis.

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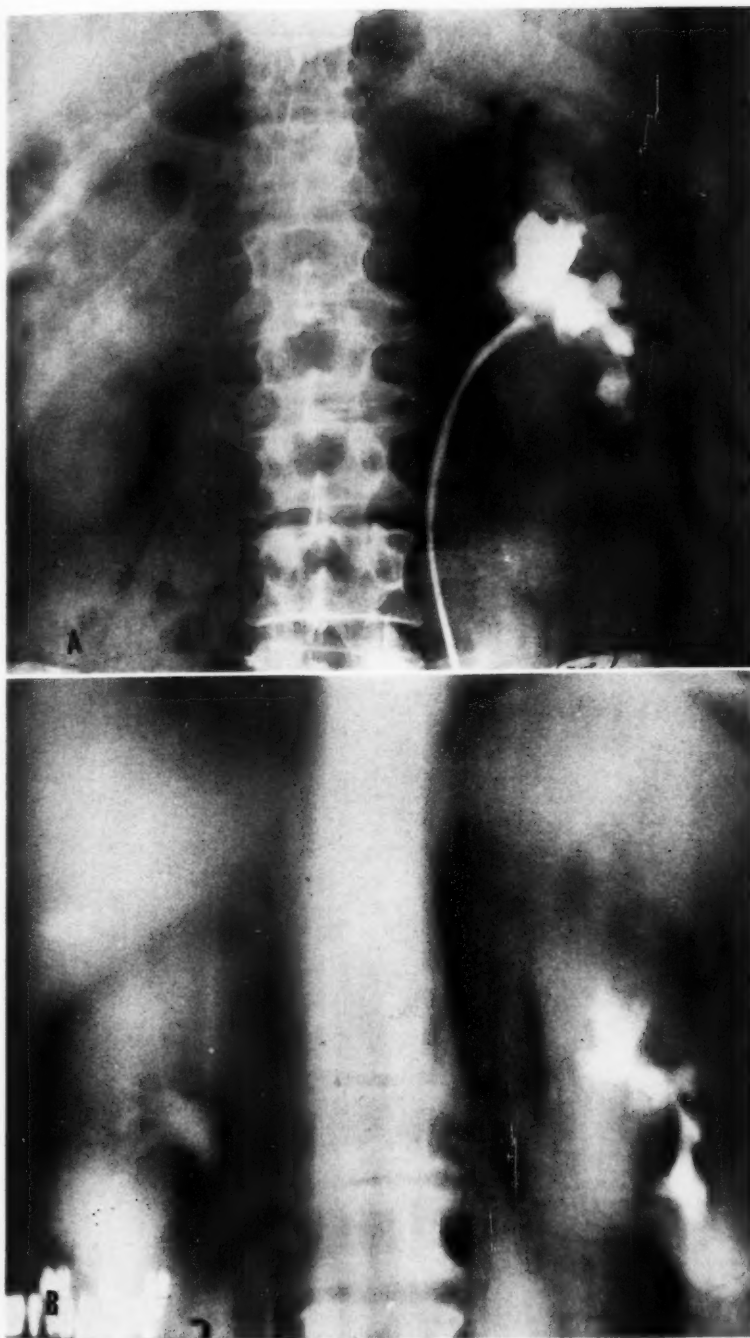


Fig. 3. Retrograde pyelogram and nephrotomogram demonstrating an oval mass protruding from the renal hilum, with compression of the renal pelvis and caliectasis. The mass proved to be a lipoma.

This is another condition which may cause renal hypertension, although the latter feature did not occur in any of our cases. Therefore, surgical extirpation of these lesions is indicated.

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John A. Evans, M.D.
525 East 68th Street
New York 21, N. Y.

SUMMARIO IN INTERLINGUA

Cystes Perivelvic Del Ren

Le occurrentia de cystes peripelvic del ren es relativemente rar. Illos es situate in le hilo del ren, in intime association con le pelve e le calyces renal. Le constata-tiones radiographic es characteristic, sed illos pote etiam esser exhibite per lipomas. In le pyelogramma excretori o retrograde il ha signos de un massa de histo molle, con compression e displaciamento del pelve renal. Il pote haber un leve grado de caliectasis causate per dysdrainage del

comprimite pelve e infundibulos. In un nephrotomogramma, un cyste peripelvic non ha le nettamente marginate radio-lucentia de un cyste parenchymal.

Iste condition es un de illos que pote causar hypertension, sed nulle hyperten-sion esseva presente in ulle del septe pati-entes vidite per le autores. In omne le casos del presente serie, le cystes esseva partialmente excidite o enucleate. Le ren non esseva removite.



Aortographic Demonstration of an Aortocaval Fistula

A Case Report¹

JAMES G. BULGRIN, M.D., and GEORGE JACOBSON, M.D.

SINCE 1909, ONLY 5 cases of a fistula between the aorta and vena cava appear to have been reported. None was associated with arteriosclerotic aneurysm, and in only 1 instance was there even mention of arteriographic study.

Lehman (1) in 1938 reported a case of aortocaval fistula with an underlying syphilitic abdominal aortic aneurysm. He found no other example in the literature after 1909. In his case the abnormal communication had existed for a maximum of four months prior to attempted surgical repair, which the patient did not survive. Other cases, appearing more recently, are

those of Bigger (2), Pemberton *et al.* (3), Freeman and Storck (4) and Decker (5). All of these followed bullet wounds.

Duration of the fistula varied from four months in Freeman and Storck's case to twelve years in that reported by Decker. The degree of cardiovascular disturbance appeared to be related directly to duration of the lesion. Thus, there was little or no abnormality of circulation in Freeman's case of four months duration, while in Decker's, after twelve years, invalidism with marked cardiac enlargement, congestive failure, and anasarca ensued. In every instance there was some modifica-



Fig. 1. Film of abdomen prior to aortography. Note calcification in aneurysmal wall to left of spine at L-3 level.

¹From the Departments of Radiology, School of Medicine, University of Southern California and Los Angeles County Hospital. Accepted for publication in February 1958.

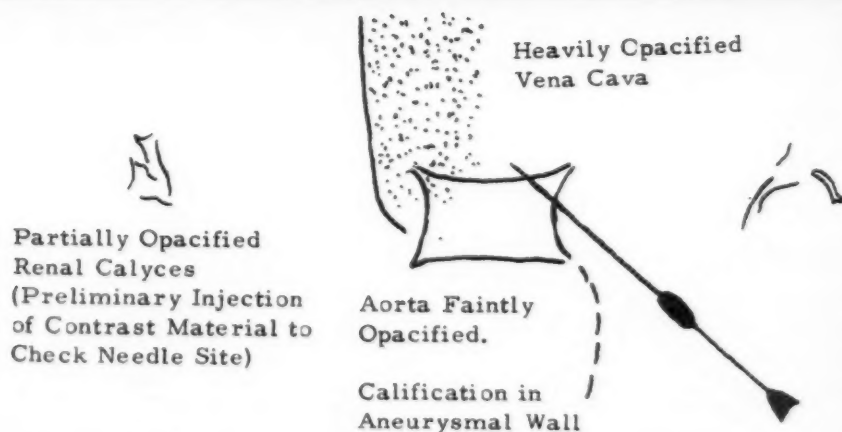


Fig. 2. Aortogram. Very faint opacification of aorta below injection site, with practically the entire bolus of contrast material entering the dilated vena cava to the right of the spine above needle.

Note: Calyces of kidneys partially opacified. Injection of 5.0 c.c. contrast material had been made ten minutes prior to final aortogram to check needle site.

The accompanying drawing outlines the findings on the aortogram.

tion of the direct shunt either by a traumatic aneurysm or an organized hematoma. It is probable, as pointed out by Freeman, that an unmodified communication be-

tween the two major vessels of the body is incompatible with any but very brief survival.

Only in the case reported by Decker

was any form of vascular opacification utilized in diagnosis. He makes mention of angiography but does not offer a detailed description.

CASE REPORT

A white male of 68 years was admitted to Los Angeles County General Hospital on March 7, 1957. For eight months prior to admission he was known to have diabetes, which was easily controlled. For the past two months he had also been under treatment for mild congestive failure with dyspnea, mild orthopnea, and ankle edema. Present hospitalization was prompted by a sudden attack of severe, generalized, non-radiating chest pain which occurred initially while straining at stool and recurred one day later. Demerol was required for relief of pain. Date of the initial episode was March 3, 1957.

On admission and during his hospital course, the patient showed signs of congestive failure with cardiac enlargement and basal râles. His blood pressure was normal, and repeated electrocardiograms showed no evidence of coronary occlusion. A second recurrence of crushing chest pain was experienced March 7. The most significant physical finding on admission and subsequent examinations was a loud bruit over the entire abdomen and back. Neither history, physical findings, roentgenographic studies, nor serology suggested syphilis.

Roentgenograms of the chest showed cardiac enlargement, pulmonary congestion, and moderate bilateral hydrothorax. Films of the abdomen showed a calcified abdominal aortic aneurysm (Fig. 1.)

Translumbar percutaneous aortography was performed on April 10, 1957. The aortic puncture was performed easily, and pulsations of the needle *in situ* as well as pulsations of arterial blood through its

lumen and attached tubing were those seen with normal aortic puncture. The aneurysm and aorta distal to the puncture site were very faintly opacified and the opaque material, almost in its entirety, entered the dilated vena cava (Fig. 2).

On April 16, 1957, operation disclosed an arteriosclerotic abdominal aortic aneurysm below the renal vessels, complicated by a communication between the aorta and vena cava 1 cm. in diameter. In the course of reparative surgery, there were two episodes of cardiac arrest. The last proved fatal. Autopsy was not performed.

SUMMARY

A case of non-traumatic aortocaval fistula complicating arteriosclerotic aneurysm of the abdominal aorta is reported because of the rarity of the occurrence and its clear demonstration by percutaneous translumbar abdominal aortography.

1200 N. State St.
Los Angeles 33, Calif.

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SUMMARIO IN INTERLINGUA

Demonstration Aortographic De Un Fistula Aorto-Caval: Reporto De Un Caso

Es reportate un caso de non-traumatic fistula aorto-caval, complicate aneurysmo arteriosclerotic del aorta abdominal. Percutane aortographia translumbar monstrava le aneurysmo e le aorta distal al sito del punctura levissimemente opacificate, proque le plus grande parte del substantia opac habeva entrate in le dilatate vena cave.

Le operation chirurgic revelava un communication inter le aorta e le vena cave, de un diametro de 1 cm. Le patiente moriva in le curso del reparos chirurgic.

Solmente 5 casos de fistula aorto-caval esseva trovate in le litteratura de post le anno 1909. In solmente 1 de illos, studios arteriographic esseva mentionate.

Gastroduodenal Intussusception¹

JOSEPH STEIN, M.D.,² BERNARD B. PERLMAN, M.D.,³ AND ALEXANDER POVALSKI, M.D.³

THE FOLLOWING case of gastroduodenal intussusception is presented because of its provocative nature, relative rarity, and the unnecessary errors in x-ray diagnosis. A review of the literature reveals confusion in the definition of gastroduodenal intussusception. In some reports no distinction is made between intussusception and prolapsing gastric polyps.

Gastroduodenal intussusception is an invagination of a portion of the full thickness of the stomach into the duodenum. When intussusception occurs in this region, spontaneous recession is common and may be observed fluoroscopically or radiographically. The present case had been diagnosed preoperatively as a tumor, but the exact dynamics of change of position of the mass was not identified. Dr. M. H. Poppel reported a similar case in 1945.

It is not the purpose of this paper to speculate upon the mechanism of intussusception. It is easy to conceive, however, that an intragastric mass would cause traction on the full thickness of the stomach and thus cause intussusception. In Poppel's case there was no associated mass and he assumed that the intussusception was based upon a disturbance of innervation.

There are no classical presenting symptoms to justify a preoperative diagnosis clinically. The patient presents abdominal symptoms which require aid from the radiologist for diagnostic evaluation.

CASE REPORT

A 60-year-old white male gave an unsatisfactory history. From his family it was learned that he had been in good health until about six weeks prior to admission, when syncope developed. During the week prior to admission he had been confused and disoriented, and had vomited.

Pertinent laboratory findings were as follows:

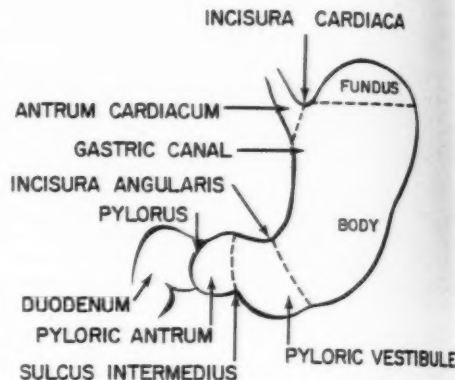


Fig. 1. Diagrammatic representation of gastric segments. The terms pyloric vestibule, antrum, and canal are clinically used interchangeably, which makes for confusion. From Gray's *Anatomy*.

hemoglobin, 4.3 gm. per 100 c.c.; hematocrit 12; microcytic hypochromic anemia. Gastric analysis showed no free acid after histamine stimulation. The x-ray examination was interpreted as showing a mass in the region of the stomach, but intussusception was not recognized.

At surgery, a large sessile polyp, measuring 4 to 5 cm. in diameter, was found prolapsed into the second and third portion of the duodenum with the pars media of the stomach intussuscepted into the pylorus and duodenum. A Billroth I subtotal gastrectomy was performed. Microscopic examination identified the polyp as malignant, with lymphatic invasion.

COMMENT

The outstanding criteria for a diagnosis of gastroduodenal intussusception are: (a) a space-occupying mass which changes its anatomical position in relation to the stomach and duodenum, thus establishing prolapse; (b) a concentric appearance of the intussusciens containing the intussusceptum. These two findings establish the diagnosis. Other criteria such as straightening of the pyloric canal, increased

¹ From the Departments of Radiology and Surgery, Veterans Administration Hospital, Bronx, New York. Accepted for publication in January 1958.

² Chief, Department of Radiology, Veterans Administration Hospital, Bronx, N. Y.; Assistant Clinical Professor of Radiology, New York University College of Medicine.

³ Resident, Surgical Service, Veterans Administration Hospital, Bronx, N. Y.

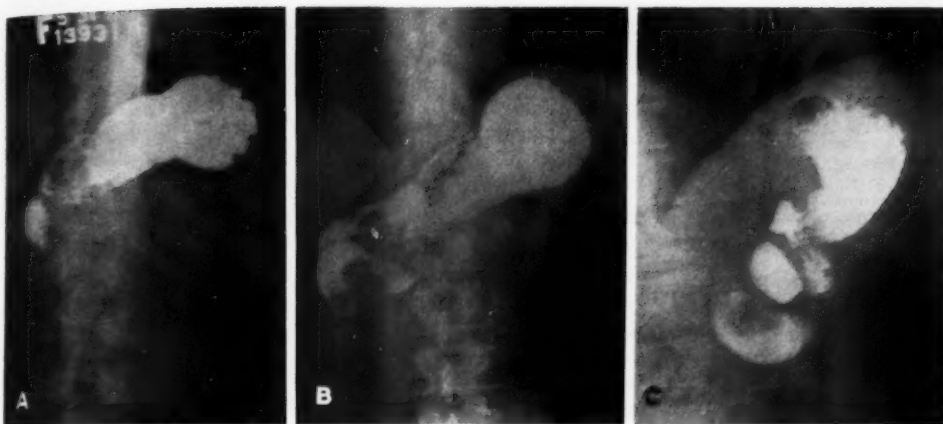


Fig. 2. Space-occupying mass in the process of intussusception.

A. Mass contained in the pyloric vestibule and antrum.

B. Mass contained in antrum and duodenum.

C. Mass has now reached a more distal duodenal segment. The intussusciens shows concentric folds. The duodenum is greatly dilated.

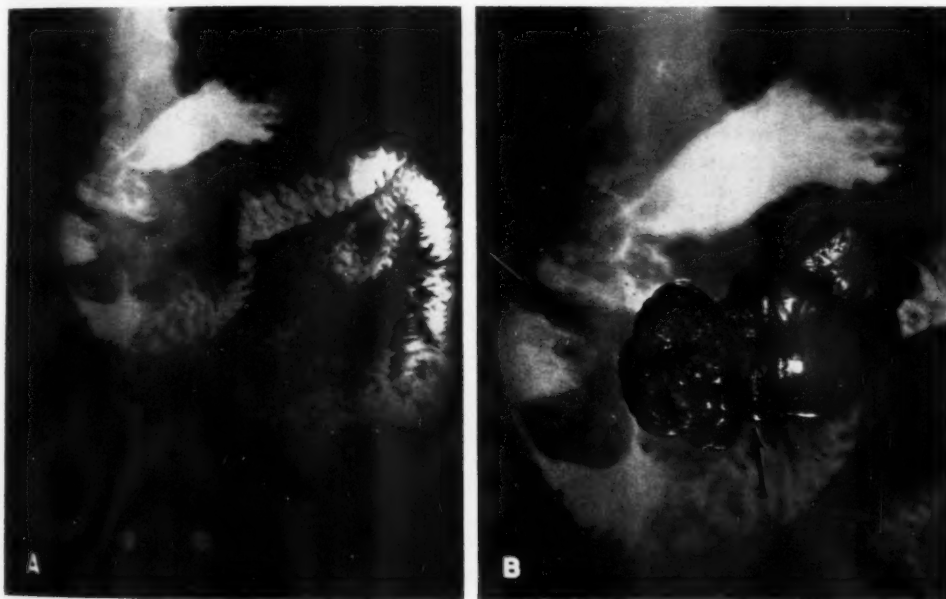


Fig. 3. A. Frontal projection of findings in Fig. 2 C.

B. Superimposed resected specimen showing the intussusception surrounded by the pyloric vestibule, antrum, and pyloric ring. The pyloric ring is greatly dilated, and the prolapsed mass is visible.

width of the duodenum, ribbon-like defect, etc., are of relatively minor importance.

It may be added that the stomach is a dynamic organ and changes shape as observed on different films. When a shifting

density is observed, surrounded by concentrically arranged tissues, intussusception may be diagnosed.

ACKNOWLEDGMENT: We are indebted to the Medical Illustration Service for preparation of the photographs.

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VA Hospital
130 W. Kingsbridge Road
Bronx 68, N. Y.

SUMMARIO IN INTERLINGUA

Intussusception Gastroduodenal

Es reportate un caso de intussusception gastroduodenal, con constataciones roentgenologic suggerente le presentia de un tumor. Al operation un pedunculate polypo de grande dimensiones esseva trovate, probabite a in le secunde e le tertie portion del duodeno, durante que le parte

medie del stomacho esseva intussuscipite a in le pyloro e le duodeno. Le prominente criterios pro un diagnose de intussusception gastroduodenal es (1) un massa tridimensional que altera su position anatomic in relation al stomacho e al duodeno e (2) un apparentia concentric del intussuscipiente.



Eosinophilic Infiltration of the Stomach

A Case Report¹

GEORGE F. JOHNSON, M.D., and ORVILLE WRIGHT, M.D.

IT IS THE purpose of this paper to present an additional example of a rare disease, eosinophilic infiltration of the stomach. This we believe is the first case to be reported in which a provisional diagnosis was made radiographically and subsequently confirmed by surgical excision and pathological examination. The clinical and radiographic findings are so similar to those in previously reported cases that awareness of the condition may permit a definitive diagnosis.

LITERATURE

In 1937, Kaijser (1) reported 3 cases illustrating the importance of allergic diseases of the bowel to the surgeon. His first case followed neoarsphenamine therapy for syphilis. Ten days after treatment the patient experienced abdominal colic, vomiting, and meteorism. The second case was similar, with symptoms of nausea, abdominal pain, and vomiting nineteen days after administration of neoarsphenamine. Both these patients were shown at surgery to have peritoneal effusions; the small bowel was red, swollen, and edematous. These findings were interpreted as representing an allergic bowel reaction to neoarsphenamine. Kaijser's third patient, with an allergic family background, experienced pain and vomiting after eating onions. Nine days following a gastrectomy for ulcer he was shown to have a 25 per cent eosinophilia.

In 1947, Sison, Dionisio, Silva, and Chavez (2) reported the case of a 31-year-old female with recurring episodes of acute abdominal pain and leukocytosis with eosinophilia. She also had ascites, with eosinophils in the peritoneal fluid. Each of four attacks was associated with pregnancy.

Herrera and de la Guardia (3), in 1948,

published a case of pyloric tumor with multiple tumors along the small bowel, associated with postoperative eosinophilia of 20 per cent. Barrie and Anderson (4), also in 1948, described a 27-year-old female with a two-weeks history of abdominal pain and vomiting. One previous attack, four years earlier, was associated with melena. This patient had a prepyloric filling defect on the greater curvature of the stomach. Eosinophilia ranged from 18 to 31 per cent three weeks after partial gastrectomy. The pathological details are included in the report.

Vanek (5), in 1949, and Polayes and Krieger (6), in 1950, described eosinophilic granulomas of the stomach and jejunum in which there was either no elevation of blood eosinophils or, at the most, a 3 per cent increase.

An extensive report of a case of eosinophilic infiltration of the stomach and bowel associated with pyloric obstruction and recurrent eosinophilia was presented by Spencer, Comfort, and Dahlin (7) in 1950. Their patient was a physician with a history of epigastric and lower abdominal cramps with diarrhea and vomiting in periodic attacks over a twelve-year period. The eosinophilia in this case reached as high as 45 per cent.

The next case, reported by Booher and Grant (8), in 1951, was similar to Vanek's.

Swartz and Young (9), in 1955, published an account of a 47-year-old woman with abdominal discomfort, subsequently shown by operation to have eosinophilic gastritis, enteritis, and peritonitis.

In 1956, Lynch, Hutchinson, and Sprague (10) reviewed the literature and added a case of their own, of pyloric obstruction due to muscular hypertrophy and massive eosinophilic infiltration of the stomach. The provisional radiographic diagnosis in our case was prompted by the similarities to this example.

¹ Accepted for publication in February 1958.



Fig. 1 (left). First stomach film, showing lack of peristalsis.

Fig. 2 (right). Second stomach film, showing fluid retention, dilatation of stomach, and shallow antral peristalsis.



Fig. 3. Dilated small bowel loops with exaggerated and ill defined mucosal pattern.

CASE REPORT

G. W., a 53-year-old married white woman, was admitted to Good Samaritan Hospital (Dayton, Ohio) on April 27, 1957, complaining of localized epigastric pain which developed fifteen minutes after eating. The pain was burning in type. For several weeks the patient had been vomiting occasionally after meals. She also had intermittent diarrhea. There were no other gastrointestinal complaints.

The patient was known to be sensitive to sulfa drugs. For two months before admission she had been suffering from asthmatic attacks. She had had an appendectomy in 1941 and a cholecystectomy in December 1955, followed by an incisional hernia.

Physical Examination: The patient was well nourished and in no acute distress. Her temperature was 98° F., pulse 80, respirations 20, blood pressure 110/80 mm. Hg. A scar was present in the right upper quadrant, with an incisional hernia, at the site of the previous cholecystectomy. Occasional irregular cardiac ventricular contractions and a wheezing type of respiration were noted.

Laboratory Studies (April 25, 1957): The urine was clear, protein-negative, and free from sugar. A voided specimen showed 8 to 10 white blood cells per high-power field. The blood count was as follows: hemoglobin 14.7 gm., hematocrit 42, red cells 4,430,000, white cells 12,800 with 21 per cent neutrophils, 23 per cent lymphocytes, 54 per cent eosino-

phils, and 2 per cent monocytes. A repetition of the count the same day showed 12,100 white cells, with 35 per cent neutrophils, 17 per cent lymphocytes, 45 per cent eosinophils, and 1 per cent basophils.

Röntgen Examination: A scout film of the abdomen on April 25 showed loops of small intestine containing gas in the mid and upper abdomen. An upper gastrointestinal study revealed a small inconstant hiatal hernia. There was no fluid in the



Fig. 4. Entire thickness of stomach wall showing muscular hypertrophy and massive invasion of eosinophils.

stomach at the beginning of the study. Peristalsis was not apparent on fluoroscopy or on the later routine films. The stomach was slightly enlarged, pliable, and of the transverse type. No intraluminal filling defects were seen, nor was there evidence of ulceration. The duodenal bulb and duodenal loop were normal in appearance. At the end of four hours considerable barium was still retained in the stomach, which was unchanged in contour except for a slight decrease in size. Exaggeration of the jejunal plicae was noted in the small-bowel mucosal study. No evidence of actual obstruction of the small bowel was observed. The conclusion from this study was as follows: "The stomach has a relatively fixed contour, without significant peristalsis. There is a differential problem between a diffuse infiltrative tumor and the possibility that the difficulty may be on a neurogenic basis. Re-examination of the stomach is recommended."

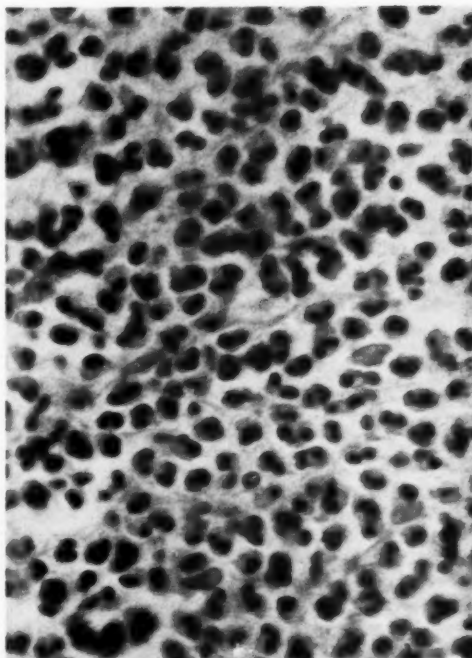


Fig. 5. Section of stomach wall showing solid sheets of eosinophils.

A repeat examination on April 27 (Figs. 2 and 3) demonstrated fluid in the stomach, which was also more distended. No peristalsis was observed on fluoroscopy. On two of the subsequent films, however, a small peristaltic wave at the junction of the antrum and the prepyloric segment was seen. At the end of three hours practically all the barium had left the stomach and was scattered along jejunal and ileal loops. These loops were more dilated than previously and contained fluid. Again the small-bowel mucosal pattern was distorted and indistinct.

Conclusion: "There is continued evidence of diffuse infiltration of the stomach, but peristalsis was demonstrated to be present, although decreased. The finding of a 54 per cent eosinophilia would suggest an allergic reaction of the stomach and small intestine. Infiltrative eosinophilic gastritis and enteritis would be considered the most likely possibility."

Course: On April 29, under general anesthesia, the old right upper quadrant scar was excised. The peritoneal cavity was found to contain 2,000 c.c. of a straw-colored fluid. After mobilization of the duodenum, palpation revealed a thickened stomach with a firm mass at the distal end. The stomach wall was edematous, as were the small-bowel loops. Because of the presence of the mass, a subtotal gastric resection with a Hofmeister type Billroth II anastomosis was performed. The tissues were

friable, and the sutures pulled out easily. Five hundred cubic centimeters of type A blood was administered during the procedure. Frozen section was done on the stomach tissue excised.

The day following operation (April 30) the patient's temperature rose to 102° F., and the urinary output was decreased. By May 2 the fever had subsided. The Levin tube was removed and a bland diet was started. On May 5 the first postoperative normal stool was passed.

On April 30, with the RISA dilution technic the following blood volume determinations were made:

	Calculated	Actual
Total blood	4,482	4,010
Plasma	2,109	2,107
Red cells	2,373	1,903
Isotope hematocrit.....	42	

A blood count on May 7 showed hemoglobin 11.5 gm., hematocrit 34, red cells 3,600,000, white cells 12,300, with neutrophils 78 per cent, lymphocytes 4 per cent, monocytes 2 per cent, eosinophils 16 per cent.

Occasionally during her hospital stay the patient received aminophylline suppositories for wheezing respirations. On May 10 she was discharged to her home with a well healed wound.

Pathology: The resected stomach showed an intact mucosa. The pyloric wall and antrum were thick, with the muscularis propria measuring 9 mm. in thickness. Microscopic study showed: eosinophilic infiltration of the mucosa; fibrous thickening of the submucosa, which was also infiltrated with eosinophils; true muscular hypertrophy of the muscularis propria with massive invasion of the interstices by eosinophils; thickened subserosa with inflammatory infiltration; serosal infiltration with eosinophils (Figs. 4 and 5).

DISCUSSION

The presentation of cases of diffuse eosinophilic infiltration of the stomach by Kaijser, Barrie and Anderson, Spencer, Comfort and Dahlin, Swartz and Young, and Lynch, Hutchinson and Sprague, seem to separate this entity from the localized tumefactions originally described by Vanek. These cases of diffuse infiltration have a close association with either a family or personal history of allergic manifestations. In the case reported here the onset of bronchial asthma about two months before operation, as well as a history of sulfa sensitization, lends support to the basic supposition that the eosinophilic infiltration is an additional manifestation

of the same allergic condition. Parenteral antigens, as originally suggested by Kaijser, remain an important explanation. There was nothing in this case to suggest parasitism, nor was any other known agent which might stimulate eosinophil production found.

The patients have been mature. Their complaints have been of epigastric or abdominal pain, vomiting, and intermittent diarrhea. The eosinophilia has ranged from a low of 11 per cent to 54 per cent in our case.

With the knowledge of peripheral eosinophilia, the radiographic findings observed in this case may be diagnostic. The stomach exhibited initial fluid retention, with mild to moderate dilatation, and shallow peristalsis in the antral segment, on the second examination. Despite this degree of peristaltic alteration, the stomach was able to empty itself by the end of three to four hours. This may be the important clue indicating that true organic obstruction of the outlet does not exist, but that generalized involvement of the stomach is present. The small bowel, if involved, will be dilated, showing either an exaggerated mucosal pattern or poorly defined mucosal folds, depending upon the degree of invasion by cells or edema. Dilated loops of small bowel containing gas are present on the plain abdominal film. If fluid is present in the abdomen in sufficient amounts, its shifting density can be an additional radiographic sign. No deforming mucosal ulceration has been found.

The severity of the massive eosinophilic invasion of the enlarged muscular layers of the bowel was the striking pathological finding. Large accumulations of eosinophils in sheets and cords involved the entire bowel thickness. The eosinophilic involvement extended right up to the resected surgical margins. The peritoneal fluid was not specifically examined with this in mind, but it would be expected to contain eosinophils because of the serosal invasion. The diagnosis could be anticipated if extensive numbers of eosinophils

were found on cytological examination of peritoneal fluid.

To date the reported cases have had some type of surgical resection for diagnosis and therapy. In extensive involvement of the stomach and small intestine, local surgical excision is less likely to be helpful than in the localized granuloma type of Vanek. With better diagnostic acumen it may be possible to bring about improvement with specific allergic therapy before the use of surgery becomes necessary. The degree of muscular hypertrophy will eventually determine what can be achieved nonsurgically.

SUMMARY AND CONCLUSIONS

1. Massive eosinophilic infiltration of the stomach as reported here and by others seems to be best explained on the basis of allergy.
2. Symptoms consist of abdominal pain, vomiting, and occasional diarrhea. Eosinophilia varies from 11 to 54 per cent.
3. Radiographically there are initial evidences of stomach outlet obstruction with decreased peristalsis. Delayed films may show no significant gastric retention.
4. Pathologically there is massive eosinophilic invasion of the layers of the bowel, with the most marked changes in the hypertrophied muscular walls. Peritoneal effusion may or may not be present.

SUMMARIO IN INTERLINGUA

Infiltration Eosinophilic Del Stomacho

Es reportate un caso de infiltration eosinophilic del stomacho, le prime—secundo le autores—in que le diagnose de iste rar condition esseva facite provisoriamente per radiologia e confirmate plus tarde per le examine pathologic.

Es opiniate que infiltration eosinophilic del stomacho—illustrate per le presente casos e per alteres ab le litteratura—se explica le melio super le base de allergia.

ACKNOWLEDGMENT. The authors wish to thank Dr. A. S. Thompson for his assistance in preparation of the pathological details in this case.

2197 Los Arrow Drive
Dayton 9, Ohio

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Le radiographia revela initialmente signos de obstruction del pyloro con reduction del peristalsis. Le intestino tenue, si interessate, es dilatate e monstra un exaggerate configuration mucosal o pauco definite plicas mucosal, secundo le grado de invasion per cellulas o edema. Le plus frappante aspecto pathologic es le massive invasion eosinophilic del pariete de stomacho e intestino.

Post-Emetic Rupture of the Esophagus

A Report of Three Cases¹

R. M. BALOW, M.D., and F. K. WIETERSEN, M.D.

THE PURPOSE OF this paper is to discuss briefly one of medicine's catastrophic conditions; namely, post-emetic rupture of the esophagus, a rather uncommon accident, but by no means a rarity. Although the history, clinical, and roentgen findings are characteristic, the diagnosis is frequently missed and the condition terminates fatally. Prompt surgical treatment is necessary if the patient is to survive.

This condition, sometimes spoken of as spontaneous rupture of the esophagus, is to be differentiated from perforation secondary to intrinsic or extrinsic disease, as well as from traumatic rupture of the esophagus from intrinsic or extrinsic causes or agents. By definition, post-emetic rupture of the esophagus is a tear through all layers of the wall of a normal esophagus as a result of vomiting.

The 3 cases to be presented here, seen during the past two and one-half years, have all ended fatally.

Spontaneous rupture of the esophagus was first described by Boerhaave in 1724. His patient was the Grand Admiral of the Netherlands Navy, and the rupture occurred as a result of vomiting and retching following ingestion of large quantities of food and alcoholic beverages. Until the 1940's, the disease was almost invariably fatal. The first successful surgical treatment was performed in 1946. The reported cases have been predominantly in males, by a ratio of 5 to 1. The average age is forty-five to fifty years.

The history often reveals overindulgence in eating and/or drinking followed by vomiting and the sudden onset of severe pain in the epigastric or substernal area. The patient becomes critically ill and the course is rapidly downhill.

Physical findings will vary depending on

the time elapsed following the rupture. Generally the patient is suffering from extreme chest or upper abdominal pain and is restless, dyspneic, and cyanotic. Often there is a nasal twang to the voice. Subcutaneous emphysema may be present in the soft tissues of the upper chest and neck. There may be evidence of hydropneumothorax either unilaterally or bilaterally. Upper abdominal rigidity may be present. It is again emphasized that the course is rapidly downhill. Sooner or later the patient goes into shock due to pain, contamination, and anoxia.

The possibility of esophageal rupture must be kept in mind if an early diagnosis is to be made. Among the conditions to be differentiated are perforated peptic ulcer, acute pancreatitis, empyema of the gallbladder, acute coronary occlusion, pulmonary embolism, and spontaneous pneumothorax. The most commonly confused condition is ruptured peptic ulcer. Many patients operated upon with this diagnosis in mind have been found to have no abdominal lesion.

The rupture is generally considered to be the result of increased intraluminal pressure, due to spasm of the pyloric and cricopharyngeus muscles with associated vomiting and retching. Experimentally, in dogs and cadavers, rupture of the esophagus has been caused by increasing the intraluminal pressure to 3 to 6 lb. per square inch. It has been found that four times the amount of pressure necessary to rupture the adult esophagus is required to produce this result in a child under the age of twelve. A sudden elevation of pressure is more important than the total amount of pressure applied.

The tear involves all layers—the outer layers first and the mucosa last. It always

¹ From The Grace Hospital, Detroit, Mich. Accepted for publication in January 1958.

develops in a vertical direction and may be only a few millimeters in length or as much as 8 cm. It is usually in the distal portion on the left posterolateral aspect just above the diaphragm, though it may occur on the right. The muscle of the distal esophagus is weaker than the muscle of the stomach and terminates in a conical fashion, the tapered end being very thin. Segmental defects are also more common in the circular muscle at the distal end of the esophagus; other inherent weakness may be present at the site of entrance of vessels and nerves. The closer relationship of the left pleura to the mediastinal portion of the tear explains the high frequency of left-sided hydropneumothorax.

The roentgen findings are characteristic and, once the diagnosis is entertained, speed is of the essence. The patient should be admitted to the hospital x-ray department, where appropriate film studies should be done—flat, upright, abdominal, and chest films. A Lipiodol swallow is of value in many cases. The usual roentgenographic findings are: mediastinal emphysema; subcutaneous emphysema; pneumohydrothorax, usually on the left (7 per cent on the right; 28 per cent bilateral). The Lipiodol will as a rule demonstrate the fistulous tract. No case has been reported with free air below the diaphragm. By correlation of the roentgen observations with other findings, even in the atypical case the diagnosis can be made and immediate therapy begun.

Once the diagnosis has been confirmed, rapid preparation for surgery is necessary. The critical period appears to be about twelve to fifteen hours after the rupture has occurred. After the fifteenth hour the mortality rises markedly. The various aspects of treatment are beyond the scope of this short review, but drainage and débridement of the mediastinum and thorax plus closure of the tear, with antibiotic and appropriate supportive measures, are the procedures of choice. Sometimes the pericardium is opened. These patients do poorly on antibiotics alone. After fifteen hours the matter of treatment

is largely determined on a clinical basis but, if at all possible, surgery offers the best hope of survival. If treatment is undertaken early, the response has often been dramatic, with marked improvement of the general condition and eventual recovery.

REPORT OF CASES

CASE I: E. L., a 57-year-old white male, was perfectly well until shortly after dinner on Dec. 23, 1954, when he suddenly vomited and felt a sharp pain in his right chest anteriorly. He was unable to take a deep breath without experiencing severe pain in this region. Having refused hospitalization, which was advised by his physician, he was given 100 mg. of Demerol intravenously. His symptoms were relieved and the following day he felt better. In the evening, however, a slight cough developed, producing an exacerbation of the pain in the right chest, which was aggravated by inspiration. The patient was then admitted to the hospital. On admission he was suffering severe pain in the right chest, his breathing was stertorous, and he appeared acutely ill, with a temperature of 99.6° F. During his hospital stay he ran a spiking fever, ranging from 97.6° to 102.2° F. Lips and skin were cyanotic.

There was dullness to percussion over the right chest posteriorly, and breath sounds and spoken voice sounds were increased over that area. There was limitation of excursion of the right chest on respiration. The left chest was normal. The heart was of normal size and the pulse was 92. The blood pressure was 100/60. The abdomen was soft and no organs or abnormal masses were palpable. There were no areas of tenderness.

A portable roentgenogram of the chest (Fig. 1) done on the evening of admission revealed subcutaneous emphysema in the left superior thorax and supraclavicular regions, with minimal involvement of the right supraclavicular area, a minimal degree of mediastinal emphysema, and infiltrative changes in the paramediastinal area and basal portion of the left lower lobe. Some localized emphysema was also seen at the left lung base. There was a large pneumohydrothorax on the right side with a fluid level at the seventh rib posteriorly. No mediastinal shift was noted. A second portable chest film (Fig. 2) was taken on the day following admission after removal of 1,600 c.c. of murky dark red and brown fluid. The right lung at this time was expanded to approximately 80 per cent of normal, but there was still fluid at the right base. Infiltrative changes were demonstrated in the partially collapsed right lower lobe, in addition to the changes previously noted in the left lower lobe. Subcutaneous and mediastinal emphysema was again noted.

Following admission, the patient was given 1 ampule of dicrysticin twice daily and 100 mg. of Demerol every four hours, as required, for pain.

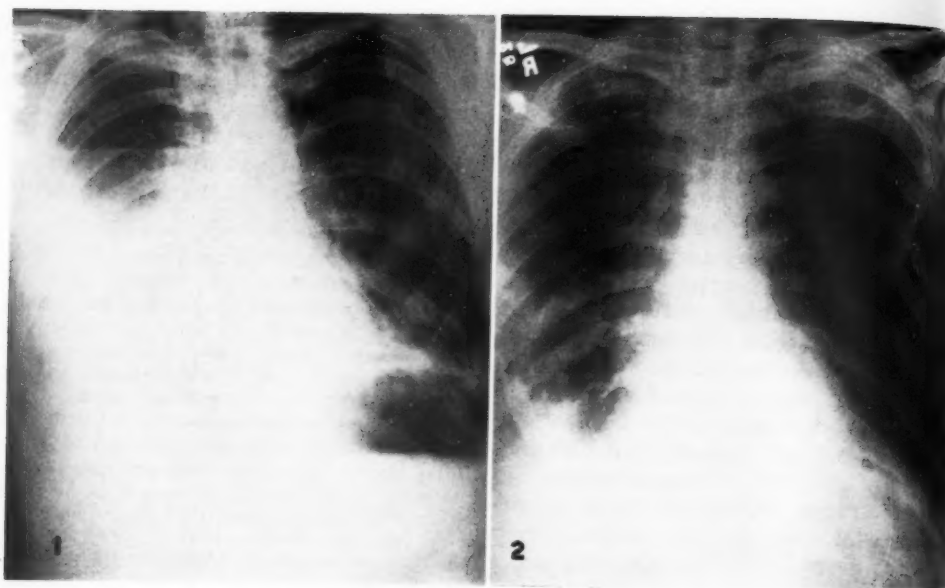


Fig. 1. Case I. Roentgenogram of chest showing right hydropneumothorax, mediastinal emphysema, and parenchymal infiltrates.

Fig. 2. Case I. Roentgenogram of chest following removal of 1,600 c.c. of fluid from right chest. Mediastinal and subcutaneous emphysema well shown.

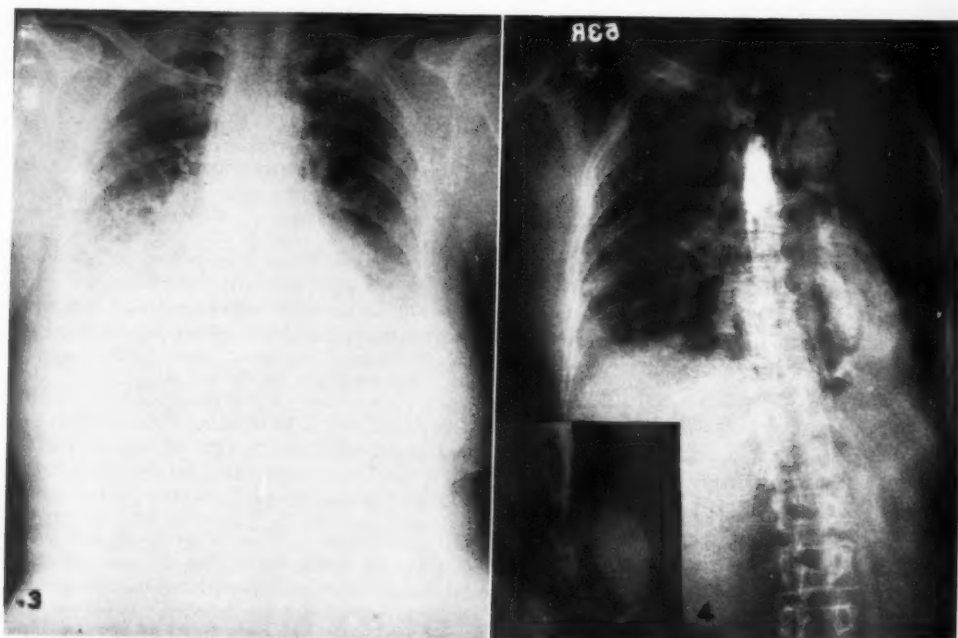


Fig. 3. Case II. Roentgenogram of chest showing bilateral parenchymal infiltrates right hydrothorax, pneumomediastinum, and subcutaneous emphysema.

Fig. 4. Case II. Barium swallow shows barium extravasating into mediastinum from tear in left posterior esophagus. Inset is spot film of same area.

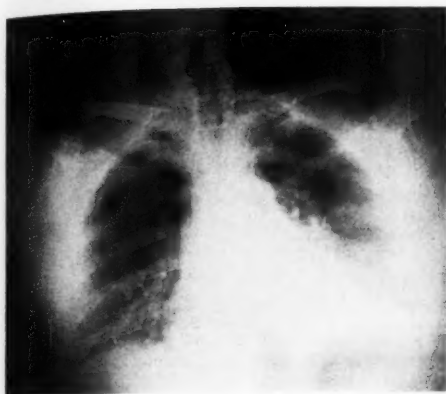


Fig. 5. Case III. Roentgenogram of the chest, showing bilateral pulmonary infiltrates, left hydrothorax, mediastinal emphysema, and subcutaneous emphysema.

A soft diet and fluids by mouth were forced. The hemoglobin on admission was 15.6 gm., the red cell count 4,900,000, and the white cell count 4,700. Two days after admission the white cells had risen to 15,300 with 93 per cent polymorphonuclears. After the thoracentesis the patient seemed to improve slightly and his chest pain subsided. A progress portable chest film obtained the following day, however, showed the right lung again to be completely collapsed. The other changes previously mentioned were the same.

Because of these findings, an intrapleural closed drainage system was set up, and once again there was some improvement. There was difficulty, however, in keeping the drainage system open; the lung tended to collapse, and the condition began to deteriorate. Pain in the chest became more severe and Demerol no longer afforded relief. The patient grew steadily worse, with increasing dyspnea in spite of administration of oxygen, falling blood pressure, and general circulatory collapse. On Dec. 29, five days after admission, he expired. Necropsy revealed a tear in the distal posterior esophagus on the right.

CASE II: Mrs. H. B., a 67-year-old white female, had a long history of intermittent abdominal distress suggestive of gallbladder disease. The evening prior to admission she had overindulged in food and at about 2:00 A.M. had become nauseated and vomited. This was immediately followed by excruciating substernal and right chest pain. The family physician reached the home at 4:00 A.M. A narcotic failed to relieve the pain, and the patient was admitted to the hospital.

Examination revealed a critically ill patient who appeared to be in shock. Marked dyspnea and circumoral cyanosis were present. There was dullness at both lung bases.



Fig. 6. Case III. Barium studies delineate tear in left posterior esophagus. Inset is spot film of lower esophagus showing barium outside of esophagus in mediastinum.

A chest roentgenogram (Fig. 3) early the following morning revealed subcutaneous and mediastinal emphysema and infiltrates at both lung bases. Correlation of clinical and roentgen findings suggested a diagnosis of ruptured esophagus, which was confirmed by a barium swallow (Fig. 4).

An operation was performed approximately twelve hours after the onset of the illness, at the beginning of which the systolic pressure was only 60. A tear in the left posterior portion of the esophagus was found to be present and was closed. There was associated evidence of severe mediastinitis and pleuritis.

The patient did poorly, and the course was continually downhill. She died in the immediate post-operative period.

CASE III (Figs. 5 and 6): G. B., a 51-year-old white male, was well until the morning of admission, when he gagged on some partial dentures. He refrained from vomiting until reaching the bathroom. Shortly thereafter he experienced a sharp severe pain in the lower back and anterior chest and marked dyspnea. The pain was somewhat relieved in the upright position.

The patient was admitted to the hospital on May 22, 1957, five hours after the onset of his illness. Examination at that time revealed an acutely ill, dyspneic, and cyanotic individual. Positive findings

on physical examination were subcutaneous emphysema of the neck, cyanosis of the lips, dullness over both lung bases, pericardial friction rub, and acute general abdominal tenderness.

Portable roentgen examination of chest revealed elevation of the left diaphragm, fluid at the left base, pneumomediastinum, and subcutaneous emphysema. Rupture of the esophagus was suggested.

The patient was operated upon approximately eight hours after initial pain, and a tear in the left posterior esophagus, just above the diaphragm, was closed.

The course was fairly favorable for the next few days. Four days postoperatively a barium swallow showed the esophageal tear to be still patent. The following day a drain was placed in the posterior mediastinum.

Unfortunately, what was thought to be a lower nephron nephrosis developed and the patient expired in uremia on the eleventh postoperative day. Necropsy revealed gross evidence of chronic fibrinous pleuritis and mediastinitis, edema of the lungs, and bronchopneumonia of left lower lobe. Microscopically the mucosa at site of tear was intact and a large amount of repair tissue was present in other tissues about lesion. The kidneys revealed evidence of chronic pyelonephritis.

SUMMARY

1. Post-emetic rupture of the esophagus is an intrathoracic catastrophe which is usually fatal if untreated.
2. The condition probably occurs more frequently than is actually reported.
3. The possibility of the lesion must be kept in mind if the diagnosis is to be made.
4. The history, signs, and symptoms are usually pathognomonic if interpreted properly.

SUMMARIO IN INTERLINGUA

Ruptura Post-Emetic Del Esophago: Un Reporto De Tres Casos

Es reportate tres casos de ruptura post-emetic del esophago. Isto es un grave condition e se termina usualmente in le morte del patiente si illo non es tractate promptemente. Le constataciones roentgenographic es characteristic: Emphysema mediastinal e subcutanee e pneumohydrothorace (plus communmente al latere sinistre). Istos—in conjunction con un historia de vomito sever, usualmente post excessos in mangiar e biber, e le observa-

5. Roentgen findings are characteristic and confirm the diagnosis.

6. Rapid surgical treatment offers the best chance for survival; twelve to fifteen hours following rupture is the critical period. The mortality is still high.

Grace Hospital
18700 Meyers,
Detroit 26, Mich.

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tion clinic de dyspnea, cyanosis, e extreme grados de dolor thoracic o supero-abdominal—deberea suggerer le diagnose. Un glutita de Lipidiol suffice usualmente pro demonstrar le ruptura. Le periodo critic es dece-duo a dece-cinque horas post le accidente. Ben que le mortalitate es alte, le responsa a un prompt intervention chirurgic es frequentemente dramatic, con alleviamento del symptomas e restablimento in le curso del tempore.

Congenital Fusion of Three Lumbar Vertebral Bodies¹

STANKO STANISAVLJEVIC, M.D.,² and ELMER G. ST. JOHN, M.D., F.A.C.R.

CONGENITAL fusion of cervical vertebral bodies is fairly common, thoracic fusion occurs less frequently, while fusion of lumbar vertebral bodies is rare. The authors had previously seen cases in which two lumbar vertebral bodies were fused, but the case to be reported here is the first which they have encountered of congenital fusion of three lumbar vertebrae.

LITERATURE

Evans (1), in an excellent paper, has adequately reviewed the embryology of the vertebral column. According to him, fusion occurs most frequently at the cervical level, and occasionally at the thoracic.

At the time of presentation of his paper, he had not seen fusion of any of the lumbar vertebrae.

Trial and Rescanières (5) reported 3 cases of lumbar vertebral body fusion. In 1 the second and third lumbar bodies were fused; in another the twelfth thoracic and first lumbar bodies, and in the third the fourth and fifth lumbar bodies. The arches were normal. These authors believe that fusion is due to congenital absence of the vertebral disk, which should appear during the first month of fetal life. In the case reported by Hadley (2) the third and fourth lumbar vertebrae were fused. Shanks and Kerley (4) state that

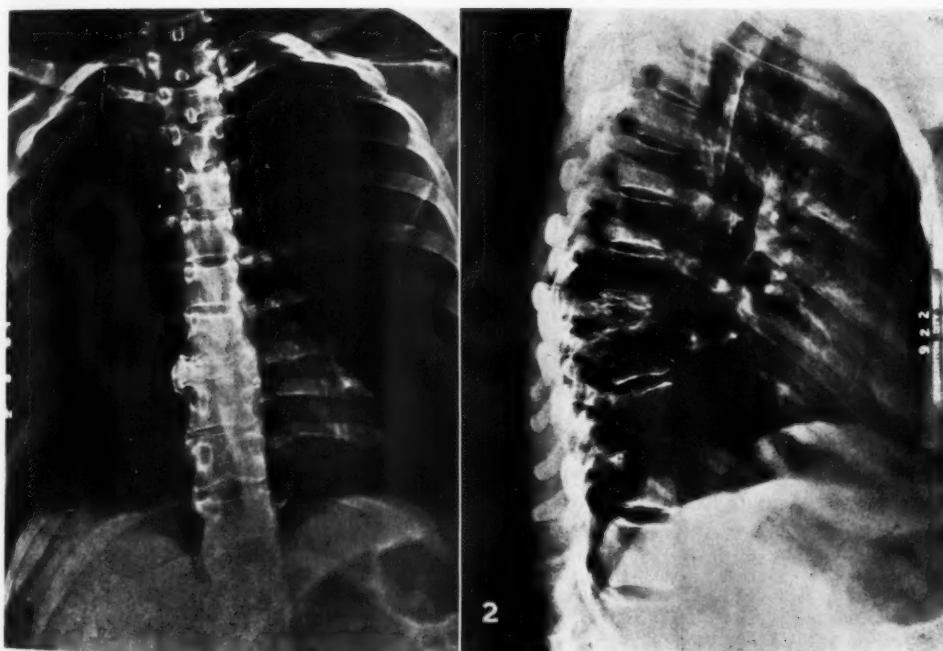


Fig. 1. Anteroposterior view of the thoracic spine. A rudimentary eighth thoracic vertebra is seen. There are twelve ribs on the left, but only eleven on the right, the eighth and ninth ribs being apparently fused.

Fig. 2. Right lateral view of the thoracic spine. The rudimentary eighth thoracic vertebra is seen.

¹ From the Departments of Surgery and Radiology, Binghamton City Hospital, Binghamton, N. Y. Accepted for publication in February 1958.

² Now at The Henry Ford Hospital, Detroit, Mich.

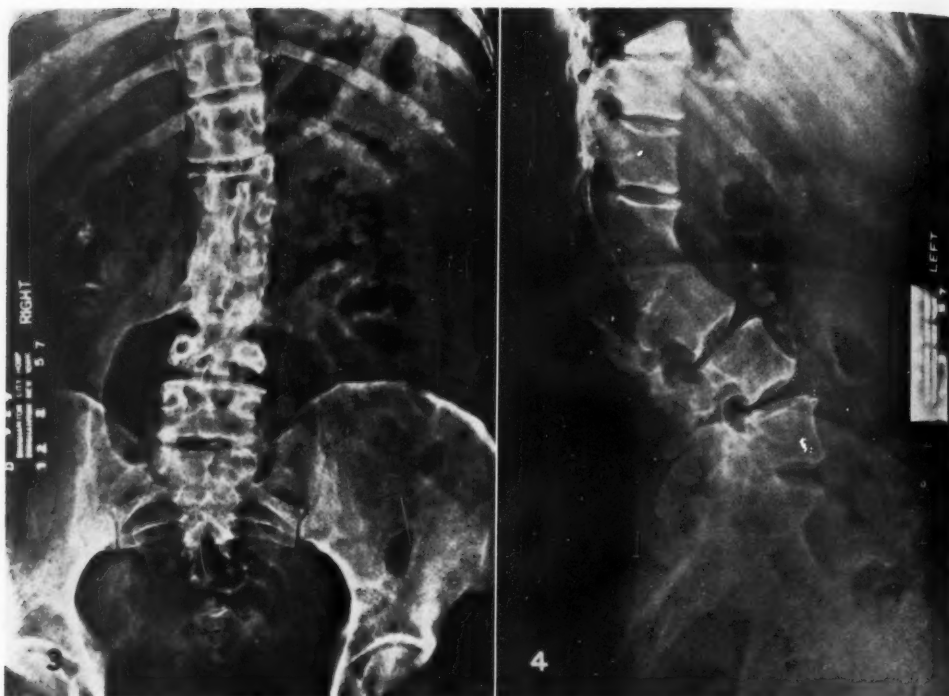


Fig. 3. Anteroposterior view of the lumbosacral region, showing minimal upper thoracic levoscoliosis and fusion of the first, second, and third lumbar bodies.

Fig. 4. Left lateral view of the lumbosacral region, showing calcification in the distal aorta, minimal anterior spurring at the fourth and fifth lumbar levels, and anterior fusion of the first, second, and third lumbar vertebral bodies. Moderate upper lumbar kyphosis is seen.

fusion may occur in any part of the spine. According to these writers the spinous processes are sometimes fused and the anteroposterior diameter of the fused or partially fused bodies may be less than normal. In Köhler and Zimmer's text (3) reference is also made to coalescence of the spinous processes, sometimes alone and sometimes in association with fusion of the bodies. An example of the former, cited by Brocher, is quoted.

CASE REPORT

A 44-year-old woman gave a history of lower thoracic and upper lumbar backache for as long as she could remember. Six years before she was seen by the authors, a lesion of the eighth thoracic vertebra was discovered at another hospital. Following this, the patient wore a brace for three years, but she still suffered considerable pain and discomfort. Physical examination revealed marked accentuation

of lumbar lordosis, and tenderness on deep pressure over the spinous processes of the tenth, eleventh, and twelfth thoracic vertebrae and over all of the lumbar vertebral spinous processes. There were no neurological changes, nor was there any family history of a similar illness.

Roentgenograms (Figs. 1-4) showed fusion of the first, second, and third lumbar vertebral bodies and a rudimentary eighth thoracic vertebra. There appeared to be fusion of the eighth and ninth ribs on the right.

SUMMARY

A single case of congenital fusion of three lumbar vertebral bodies has been presented. An associated anomaly was hypoplasia of the eighth thoracic vertebra, with congenital fusion of two ribs on the right at this level.

NOTE: The reproductions for this paper were made by the LogEtronic method.

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The Henry Ford Hospital
Detroit 2, Mich.

SUMMARIO IN INTERLINGUA

Fusion Congenite De Tres Corpores Lumbo-Vertebral

Le fusion congenite de duo o plus corpores lumbo-vertebral es inusual. Un caso es reportate in que le prime, secunde, e tertie corpore lumbo-vertebral

esseva fusionate. Con iste anomalia esseva associate hypoplasia del octave vertebra thoracic e fusion del octave e none costa a un latere.

EDITORIAL

Forty-Fourth Annual Meeting The Radiological Society of North America

The members and friends of the Radiological Society of North America will assemble in Chicago at the Palmer House Nov. 16-21, to be the guests of those generous and almost perennial hosts, the members of the Chicago Roentgen Society, who have for so many years borne the pleasant burden of the local management of this large meeting. It is a tribute to their sense of professional and civic responsibility that they welcome our presence so frequently with complete cordiality.

The refresher course program, enlarged last year, will continue with much the same pattern. There will be a number of exercises on Sunday, Nov. 16, two series of courses on Monday morning, and one series each morning thereafter. Dr. John W. Walker and his Refresher Course Committee have arranged a very excellent educational program, the details of which are announced in this issue of RADIOLOGY.

A large group of excellent Scientific Exhibits has been assembled by the Scientific Exhibits Committee under the chairmanship of Dr. Everett L. Pirkey. Dr. John H. Gilmore continues to serve as chairman of the Commercial Exhibits Committee and he promises another excellent demonstration of newer developments in the technical field.

The details of the preliminary program are published in this issue and need not be discussed here. I would call attention, however, to certain departures from previous custom which are embodied in this program. A very substantial portion of the papers to be presented have been offered as a result of the solicitation of the entire membership by individual letters.

As might be expected, the Program Committee has had presented to it many more papers than could be effectively used. All of us regret exceedingly the necessity for refusing so many excellent proposals. At the same time, we were enormously gratified at the wealth of excellent investigation which is now current among radiologists generally.

We are presenting this year, for the first time, a session on "Research in Progress" to occupy the diagnostic sectional program on Thursday morning. An effort is made here to present to all the members of the Society some of the basic research, largely the work of younger radiologists, which is under way in many medical schools throughout the country. Likewise, on Friday morning, the papers on cardiovascular diagnosis embody many new and important developments in this rapidly expanding field.

The Society is again indebted to Lauriston Taylor and Harold Wyckoff for arranging programs on Radiation Biology and Physics as they have done in previous years. In addition, we are thankful to Drs. H. L. Friedell, Herbert Stauffer, Henry Kaplan, Robert Robbins, and Laurence Robbins for arranging symposia on a wide variety of subjects. Dr. Benjamin Felson has undertaken to present a clinic and panel discussion on the Diagnosis of Diseases of the Chest.

We are honored this year by the presence on our program of two colleagues from England, who will be the guests of the Society. Dr. Alan S. Johnstone, Professor of Radiology at the University of Leeds, is well known to American radiologists, especially for his work on the esoph-

agus. He will present his most recent thoughts on the Radiological Anatomy of the Distal End of the Esophagus, a subject greatly in need of clarification. Dr. C. J. Hodson, long associated with, and now the successor to Dr. S. Cochrane Shanks at the University College Hospital in London, will present two papers embodying some of his illuminating investigations of the kidney and its circulation.

Particular attention is directed to the Friday morning program in which there will be two sections. One of these is devoted entirely to a Symposium on Cardiovascular Diagnosis. I believe some of these papers will be of the first importance. In the other section on Friday morning there will be a large number of excellent papers on Radiation Therapy, in addition to a number on the diagnosis of kidney lesions. Our guest, Dr. C. J. Hodson, will present another paper at this time.

The Carman Lecture, Thursday evening, should have a particularly appropriate appeal to radiologists, mindful of its historic origin. The subject, "Carcinoma of the Stomach," which occupied so much of Russell Carman's energies and, ironically enough, was the cause of his death, is one of interest to us all. The speaker, Dr. Owen H. Wangensteen, Professor of Surgery at the University of Minnesota, is one of the foremost authorities on this subject. His address promises to continue the long line of distinguished lectures honoring the memory of Dr. Carman.

As last year, there will be no formal banquet. The awarding of medals, scrolls, Scientific Exhibit prizes, and the induction of new officers will all take place on Thursday night.

The Women's Auxiliary of the Chicago Roentgen Society will extend their usual generous hospitality and arrange for entertainment for the ladies. A meeting room where social gatherings can be held will be available.

The Women's Committee chairmen, Mrs. Warren Furey and Mrs. John Gilmore, have my heartfelt thanks for their continuing efforts, as do the officers of the Chicago Roentgen Society, headed by Dr. Irwin Hummon, for their help and co-operation.

I should like at this time to express my sincere thanks to all the speakers, counselors, officers, the members of the various committees, and particularly to the members of the Program Committee, for the great help that they have given me in planning this meeting. I have especially appreciated the help of that veteran of many programs, Dr. Donald S. Childs, Sr., and his faithful assistant, Mrs. Marguerite Henry. I am confident this assembly will carry on the fine traditions of the Society as a force for the continuing education of radiologists, the exposition of new ideas, and the further scientific development of radiology. The members, their friends, and guests are cordially invited to attend.

LEO G. RIGLER, M. D.



ANNOUNCEMENTS AND BOOK REVIEWS

LOS ANGELES RADIOLOGICAL SOCIETY

The Los Angeles Radiological Society recently elected the following officers for the coming year: President, Lewis J. Peha, M.D.; Vice-President, Putnam C. Kennedy, M.D.; Secretary, Robert B. Engle, M.D., St. Luke Hospital, Pasadena; Treasurer, Robert E. Rickenberg, M.D.; Member of the Executive Committee (three years), Richard A. Kredel, M.D.

MEMPHIS ROENTGEN SOCIETY

At a recent meeting of the Memphis Roentgen Society, the following were elected to office: Dominic J. Cara, M.D., President; Edward H. Mabry, M.D., Vice-President; James L. Booth, M.D., 899 Madison Ave., Memphis, Secretary-Treasurer; J. E. Whiteleather, M.D., Councilor to the American College of Radiology; John M. Wilson, M.D., Alternate Councilor.

SECOND SYMPOSIUM ON X-RAY MICROSCOPY AND MICROANALYSIS

The Second Symposium on X-Ray Microscopy and X-Ray Microanalysis will be held at the Karolinska Institutet in Stockholm, June 15-17, 1959. The Symposium will deal with new developments in x-ray microscopy and x-ray microanalysis as well as applications of these technics to various research disciplines.

The registration fee will be 50 Sw. Cr. for active participants, and 25 Sw. Cr. for accompanying persons. The final date for registration is March 15, 1959.

Requests for further information should be addressed to Second Symposium on X-Ray Microscopy and X-Ray Microanalysis, Dr. G. Höglund, Institutionen för Medicinsk Fysik, Karolinska Institutet, Stockholm 60, Sweden.

COURSES: QUEENS HOSPITAL CENTER NEW YORK

A course in Operative Radium Therapy is being offered at the Queens Hospital Center, Jamaica, N. Y., beginning Saturday, Nov. 1, 1958, and continuing for eight consecutive Saturdays, from 9 A.M. until noon. The program will cover interstitial radiation in the oral cavity; radical insertion of radium in the neck; the use of various applicators in carcinoma of the cervix and of the Heyman applicators in carcinoma of the endometrium; radium needles in the parametria; and radon, iridium-thread, and cobalt interstitial therapy.

A course in Radioactive Isotopes for Technicians is also being offered in eight sessions of four hours each, to be held Wednesday afternoons (1 to 5 P.M.)

commencing Oct. 1, 1958, and ending Nov. 10, 1958. Sessions will be divided equally between lectures and laboratory work.

Tuition for each of these courses is \$100.00.

Requests for applications should be sent to Dr. Philip Kahan, Supervising Medical Superintendent, Queens Hospital Center, 82-68 164th St., Jamaica 32, N. Y.

MARY PUTNAM JACOBI FELLOWSHIP

The Women's Medical Association of the City of New York is offering to a qualified graduate woman physician the Mary Putnam Jacobi Fellowship, amounting to \$2,000, for medical research, clinical investigation, or postgraduate study in a special field of medicine. Work under the fellowship is to begin Oct. 1, 1959. Applications must be made by Feb. 1, 1959. Details may be obtained from Ada Chree Reid, M.D., Secretary, 118 Riverside Drive, New York 24, N. Y.

Letters to the Editor

To the Editor of Radiology

DEAR DOCTOR DOUB:

Our paper "Comparative Radiotherapeutic Results in Carcinoma of the Endometrium as Modified by Prior Surgery and Post-Irradiation Hysterosalpingo-oophorectomy" published in *RADIOLOGY* 66: 653-66, May 1956, stressed the advantages of postoperative vaginal irradiation and of preoperative radiotherapy followed by total hysterosalpingo-oophorectomy. The original recommendations were based on our experience with cases treated from 1937 through 1948. On the basis of more recent clinical experience, by ourselves and others, it now seems desirable to modify somewhat our original recommendations relating to routine postoperative vaginal irradiation and use of preoperative radiotherapy, particularly for low-grade, well delimited carcinomas occurring in uteri of small to average size.

We still feel that postoperative vaginal irradiation is indicated in patients with high-grade neoplasms and extensive lesions which infiltrate the myometrium, permeate lymphatics, or extend into the endocervix. However, in the case of low-grade tumors of small size, without evident invasion of the myometrium or obvious permeation into the lymphatics, we would now advise that immediate radiotherapy be withheld. Such cases should be carefully followed postoperatively and, in the event local recurrence develops, vaginal irradiation should then be promptly administered. Prophylactic postoperative irradiation by means of roentgen rays transvaginally or vaginal applicators containing radioactive sources must be conducted meticulously and

with conservative dosimetry. Tolerance of the tissues for radiotherapy will have been impaired through reduction of the regional blood supply by prior surgery. Cancerocidal dosage causes vaginitis, which may lead to postirradiation adhesions, the separation of which may cause bleeding and ulceration. After high dosage, cystitis, proctitis, ulceration, and even fistulae may develop.

In patients presenting a low-grade, well delimited carcinoma of the corpus in a freely movable uterus of small to average size, we are increasingly inclined to advise immediate hysterectomy and to withhold preoperative radiotherapy. Preoperative radiotherapy is of value primarily in the undifferentiated and the more extensive carcinomas encountered more commonly in uteri of larger than average size and in lesions involving the region of the endocervix. In the process of intrauterine introduction of radium capsules, the therapist must always bear in mind the possibility of applicators passing through a hole in the uterine wall into the peritoneal cavity. Penetration may occur through an area of infiltrating necrotic tumor or through a prior or current instrumental perforation of the uterus.

The dosage in roentgens should be calculated or measured not only to the tumor but also to the rectum, bladder, and, in postoperative cases, to the small bowel also. The dose administered as a preoperative measure may be reduced to about three-fourths of the total ordinarily administered when radiotherapy constitutes the complete treatment without plans for subsequent hysterectomy. External roentgen therapy contributes less than intracavitary radium to the control of most endometrial carcinomas and may be omitted as a preoperative measure in certain cases, particularly in obese patients. When external roentgen therapy is utilized preoperatively, the line of incision for proposed subsequent hysterectomy may be shielded by lead. Total hysterosalpingo-oophorectomy is our primary treatment of choice in carcinoma of the endometrium. Treatment by intracavitary radium and external roentgen therapy *alone* is restricted to patients who are technically or clinically inoperable.

Very truly yours,

HOWARD B. HUNT, M.D.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

TUMORS OF THE SKIN. By HERBERT Z. LUND, M.D., Director of Laboratories, The Moses H. Cone Memorial Hospital, Greensboro, North Carolina, Visiting Professor of Pathology, University of North Carolina, Chapel Hill, North Carolina.

Atlas of Tumor Pathology, Section I—Fascicle 2. A volume of 332 pages, with 265 figures and 1 colored plate. Published by the Armed Forces Institute of Pathology, under the auspices of the Subcommittee on Oncology of the Committee on Pathology of the Division of Medical Sciences of the National Academy of Sciences—National Research Council, Washington, D. C., 1957. For sale by the American Registry of Pathology, Armed Forces Institute of Pathology, Washington 25, D. C. Price \$3.00.

TUMORS OF THE ESOPHAGUS. By ARTHUR PURDY STOUT, M.D., Professor of Surgery, Emeritus, and Professor of Pathology, Retired, Columbia University, College of Physicians and Surgeons, and RAFFAELE LATTES, M. D., Professor of Surgery, Columbia University, College of Physicians and Surgeons, New York. **Atlas of Tumor Pathology, Section V—Fascicle 20.** A volume of 108 pages, with 58 figures and 2 colored plates. Published by the Armed Forces Institute of Pathology, under the auspices of the Subcommittee on Oncology of the Committee on Pathology of the Division of Medical Sciences of the National Academy of Sciences—National Research Council, Washington, D. C., 1957. For sale by the American Registry of Pathology, Armed Forces Institute of Pathology, Washington 25, D. C. Price \$1.00.

TUMORS OF THE LIVER AND INTRAHEPATIC BILE DUCTS. By HUGH A. EDMONDSON, M.D., Professor of Pathology, University of Southern California, School of Medicine, Los Angeles, California. **Atlas of Tumor Pathology, Section VII—Fascicle 25.** A volume of 220 pages, with 207 figures and 6 colored plates. Published by the Armed Forces Institute of Pathology under the auspices of the Subcommittee on Oncology of the Committee on Pathology of the Division of Medical Sciences of the National Academy of Sciences—National Research Council, Washington, D. C., 1958. For sale by the American Registry of Pathology, Armed Forces Institute of Pathology, Washington 25, D. C. Price \$2.25.

MEDICAL ELECTRICAL EQUIPMENT: PRINCIPLES, INSTALLATION, OPERATION AND MAINTENANCE OF ELECTRICAL EQUIPMENT USED IN HOSPITALS AND CLINICS. Advisory Editor: ROBERT E. MOLLOY, M.B., F.F.A., R.C.S. A volume of 312 pages, with 238 figures. Published by Philosophical Library Inc., 15 East Fortieth St., New York 16, N. Y., 1958. Price \$15.00.

A PRACTICAL MANUAL ON THE MEDICAL AND DENTAL USE OF X-RAYS WITH CONTROL OF RADIATION HAZARDS. By RICHARD H. CHAMBERLAIN, M.D., with the assistance of ROBERT J. NELSEN, D.D.S., and the COMMISSION ON UNITS, STANDARDS, AND PROTECTION OF THE AMERICAN COL-

LEGE OF RADIOLOGY. Sponsored by the American College of Radiology and the American Dental Association. A brochure of 32 pages with numerous drawings and charts. For sale by the American College of Radiology, 20 North Wacker Drive, Chicago 6, Ill. Price 25 cents.

SELECTED PAPERS FROM THE INSTITUTE OF CANCER RESEARCH: ROYAL CANCER HOSPITAL AND FROM THE ROYAL MARSDEN HOSPITAL, 1956. VOLUME 11, containing 928 pages, with figures and tables. Published by order of the Committee of Management of the Institute and the Board of Governors of the Royal Marsden Hospital, London, 1958.

PREPARATION, MAINTENANCE, AND APPLICATION OF STANDARDS OF RADIOACTIVITY. By W. B. MANN and H. H. SELIGER. National Bureau of Standards Circular 594. A monograph of 48 pages, with 42 figures and 4 tables. For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., 1958. Price 35 cents.

TUMORI RARI DEL POLMONE. By P. PIETRI, S. SALVANESCHI, A. PERACCHIA, and G. GALLO, Clinica Chirurgica Generale dell'Università di Milano. Preface by G. Oselladore. A volume of 146 pages, with 77 figures. Published by Casa Editrice Renzo Cortina, Viale Camillo Golgi 14, Pavia, Italy, 1957. Price L. 2,500.

LE MÉDIASTIN ET SA PATHOLOGIE. By MAURICE BARIÉTY, Professeur de Clinique Médicale à l'Hôtel Dieu, Membre de l'Académie de Médecine, and CHARLES COURVY, Médecin des Hôpitaux de Paris. A volume of 854 pages, with 312 figures. Published by Masson et Cie, 120, Blvd. Saint-Germain, Paris, 6^e, France, 1958. Price 11,000 francs.

Book Reviews

DR. W. C. RÖNTGEN. By OTTO GLASSER, Ph.D., F.A.C.R. (Assoc.), Holder of Röntgen-Honor-Plaque of the Röntgen-Museum in Remscheid-Lennep, 1951; Professor of Biophysics, Frank E. Bunts Educational Institute; Head, Department of Biophysics, Cleveland Clinic Foundation, Cleveland, Ohio. Second edition. A volume of 170 pages, with 14 illustrations. Published by Charles C Thomas, Springfield, Ill., 1958. Price \$4.50.

It is a pleasure to see in print again Otto Glasser's little book on Dr. W. C. Röntgen. Actually the book is a reprint of the original which appeared in 1945, since little new information has become available in the interval to require changes in the text. Some new illustrations have been introduced and a number of recent titles are added to the bibliography.

Since the work has been unavailable for a number of years, there will be many of the younger radiologists who are unfamiliar with it. It is recommended to these and others as an interesting contribution to the history of their specialty.

ÉTUDE RADIOLOGIQUE DE LA CIRCULATION VEINEUSE DU MEMBRE SUPÉRIEUR (SUJET NORMAL). By ERCOLE LAVIZZARI and VALERIO OTTOLINI. Prefaces by MM. les P^{rs} R. Fontaine and F. Perussia. Adaptation and translation from Italian by J. Bories and D. Dilege. A monograph of 122 pages, with 38 figures. Published by Masson & Cie, 120, Boulevard Saint-Germain, Paris 6^e, France, 1958. Price, paper bound, 2,400 francs.

The authors of this monograph are interested in the roentgenologic study of blood vessels, more especially the veins of the upper extremity.

Technical and anatomic descriptions of the procedures involved in studying the hand, forearm, elbow, arm, and axilla are given in separate chapters. Diodone (similar to iodopyracet or Diodrast) is used in 30 to 35 per cent solution and is usually injected at about 1 to 2 c.c. per second. To study the hand, about 8 c.c. of contrast agent is injected in fifteen seconds into the cephalic vein of the thumb.

For the forearm, 30 to 35 c.c. is injected unless a block is suspected, in which case the amount is reduced to about 10 c.c. The deep veins are shown better with a tourniquet around the distal part of the forearm. A fairly good demonstration of both deep and superficial veins may be obtained by placing the tourniquet near the elbow.

The contrast agent may be injected more rapidly in the arm veins, up to 7.0 c.c. per second. The greater speed of injection helps to demonstrate more of the veins. A tourniquet around the upper arm, released just before the roentgen exposure, aids in demonstrating the axillary veins.

In studying the axilla 30 c.c. of 30 to 50 per cent Diodone is injected into the basilic or median basilic vein at a rate of 2.5 to 3.0 c.c. per second. The innominate vein and superior vena cava may also be demonstrated.

Caution must be used in interpreting an interruption of the opacified column unless collateral vessels are filled.

PHYSIKALISCHE GRUNDLAGEN DER RÖNTGENDIAGNOSTIK. By DR. PHIL. G. SPIEGLER, F. Inst. P., F. R. P. S., London, England. With a Foreword by Prof. Dr. H. R. Schinz, Zürich. A volume of 94 pages, with 71 figures. Published by Georg Thieme Verlag, Herdweg 63, (14a) Stuttgart, Germany, 1957. Distributed in United States and Canada by Intercontinental Medical Book Corporation, New York, N. Y. Price DM 18.—(\$4.30).

The author has joined the ranks of those physiologists who, after exploring the field of therapy suc-

cessfully, have turned their investigative interest toward the physical aspects of roentgen diagnosis, "the newest frontier." The reader is asked to do likewise, for many of the complex factors in image formation are explained in terms of radiotherapy. The problems of radiographic exposure, patient absorption, absorptional contrast, scattered radiation, tube output, filters, etc., are expressed in terms of half-value layers, absorption coefficient, field size, loss and gain of depth dose by scattering, and other concepts which are mainly familiar to the radiotherapist. Even the heat dissipation and instantaneous load limit of x-ray tubes for rapid sequence exposures are likened to fractionation in radiotherapy whereby minutes of tube cooling are made equivalent to weeks of biologic recovery.

In similar fashion, use is made of analogies with events occurring in our daily lives for the purpose of explaining problems of vision, contrast, sharpness, density, brightness range, blurring, motion, grid effect, superimposition of patterns, dominance of one pattern over another, and related features. Thus the text is enlivened by frequent allusions to hunting, sailing, mountain climbing, night driving, etc.

The main purpose of the book is to *explain* the phenomena of taking and reading radiographs and not merely to present facts in a dry non-directional manner. It requires of the reader practically no prior knowledge in this field. Any radiologist who reads films and fluoroscopes can follow the discussion without difficulty (though he will be aided by experience in radiotherapy). The author has not, however, in his readability sacrificed scientific accuracy to oversimplification; he supports most of his statements by curves, which preponderate over tables and mathematical formulae.

The emphasis is on *qualitative* relationships of various factors to each other and on their effect upon the formation of radiographic images. Quantitative relationships are used mainly as examples to illustrate a qualitative trend. Thus the book is not intended to serve as a collection of "useful" formulae and tables. It does contain, however, some valu-

able observations on radiation protection, with examples of dosages (particularly those of scattered radiation).

It is natural that such a treatise cannot be complete. Much has been omitted—as it appears—by intent in order to give the book didactic unity. For instance, the problem of secondary radiation grids is not discussed. The author refers mainly to work of his British colleagues and to continental literature. An example is the prominence given to Greening's method of measuring the tube voltage by determining with chambers the ratio of transmitted to emitted characteristic radiation, whereas the use of a pulse-height analyzer is not mentioned. Also the problem especially confronting the American radiologist—namely, the need to read large numbers of cases rapidly and to view up to twenty films of a single given case simultaneously in a room equipped with large banks of illuminators—is not discussed. The virtues of scanning a radiograph and viewing dark areas of the film separately from light areas are therefore extolled beyond practicability. (In this country it is better to limit the maximum density of radiographs so that scanning becomes unnecessary, with a diagnostic synthesis made possible by simultaneous viewing.)

The author should be commended on his frank and clear stand on the undesirability of high contrast in many instances. Not only has he developed a method of his own to reduce contrast by "counter printing," but his book will be salutary to all those who continue to judge the superiority of one piece of radiographic equipment over another primarily by its ability to produce higher contrast. It is regrettable, in this connection, that the book went to press before the LogEtronic process and the exciting new possibilities of low silver content emulsions became more widely known. One hopes that the next edition will include a chapter on this subject.

In all, this is an excellent book for the radiologist who considers himself a novice in the physics, physiology, and psychology of roentgen diagnosis and desires a rapid introduction to this field.



RADIOLOGICAL SOCIETY OF NORTH AMERICA

FORTY-FOURTH ANNUAL MEETING: PRELIMINARY PROGRAM

Palmer House, Chicago, Illinois, Nov. 16-21, 1958

Monday, November 17

OPENING SESSION: 2:00-4:30 P.M.

SECTION AB

Robert D. Moreton, M.D., First Vice-President
Presiding

Call to Order.

Greetings and Introductions.

President's Address. LEO G. RIGLER, M.D.

Memorial Fund Lecture. Ultrasound: A New Diagnostic Tool. DOUGLASS H. HOWRY, M.D. Introduced by W. WALTER WASSON, M.D.

Symposium: The Use of Isotopes in Diagnosis. Arranged by H. L. FRIEDEL, M.D., Presiding.

Hemodynamics: Interpreted by Means of Multiple Scintillation Detectors Placed Over the Anterior Thoracic Wall. REX L. HUFF, M.D., DANIEL PARRISH, B.S., and WAYNE CROCKETT, M.D.

Some Clinical Applications of Isotope Circulation Studies in Congenital Heart Disease. RICHARD H. GREENSPAN, M.D., RICHARD G. LESTER, M.D., KURT AMPLATZ, M.D., and JAMES F. MARVIN, Ph.D.

Developments in Positron Scanning for Localization of Focal Intracranial Lesions. WILLIAM H. SWEET, M.D.

Visualization of Some Internal Structures with Special Reference to the Liver and Large Blood Masses. WILLIAM J. MACINTYRE, M.D., H. L. FRIEDEL, M.D., and ABBAS M. REJALI, M.D.

Liver Function Studies with Rose Bengal I¹³¹. GEORGE V. TAPLIN, M.D., ORSELL M. MEREDITH, Ph.D., and DELORES E. JOHNSON, M.D.

The Use of the TSH Test in the Diagnosis of Thyroid Disorders. W. McK. JEFFERIES, M.D., R. P. LEVY, M.D., and J. P. STORAASLI, M.D.

BUSINESS MEETING: 4:30 P.M.

Tuesday, November 18

SECTION A: 10:30 A.M.-12:30 P.M.

H. Milton Berg, M.D., Presiding

Congenital Insensitivity to Pain: A Neurologic Syndrome with Bizarre Skeletal Lesions. FREDERIC N. SILVERMAN, M.D., and JEROME GILDEN, M.D.

The Postoperative Myelogram. MAURICE L. SILVER, M.D., EUGENE A. FIELD, M.D., CAROLL M. SILVER, M.D., and STANLEY D. SIMON, M.D.

Upright Dynamic Myelography. IVAN M. WOOLLEY, M.D., BRUCE N. KVERNLAND, M.D., and RAY V. GREWE, M.D.

The Significance of Bilateral Basal Ganglia Calcification. ROY H. MAFFLY, M.D., JOHN C. BENNETT, M.D., and HOWARD L. STEINBACH, M.D.

The Roentgenologic Manifestations of Meningiomas of the Tuberculum Sellae. ROBERT L. TUCKER, M.D., COLIN B. HOLMAN, M.D., COLLIN S. MACCARTY, M.D., and MALCOLM B. DOCKERTY, M.D.

Intracranial Meningiomas: A Study of 126 Cases. HAROLD G. JACOBSON, M.D., HERMAN LUBETSKY, M.D., JEROME H. SHAPIRO, M.D., and CHARLES A. CARTON, M.D.

The Systematic Use of Tomography in the Diagnosis of Carcinoma of the Paranasal Sinuses. GERALD D. DODD, M.D., LOIS C. COLLINS, M.D., and ROBERT L. EGAN, M.D.

SECTION B: 10:30 A.M.-12:30 P.M.

Henry S. Kaplan, M.D., Presiding

SYMPOSIUM: RADIATION BIOLOGY

Prepared by

Henry S. Kaplan, M.D., and Robert Robbins, M.D.

Shortening of the Life Span as a Measure of the Late Effects of Ionizing Radiation. HENRY I. KOHN, M.D.

Radiation Carcinogenesis. AUSTIN BRUES, M.D.

Cell Renewal and Acute Radiation Damage. HENRY QUASTLER, M.D.

The Effect of Combined Radiation and Chemotherapy on Cancer Growth, with Special Reference to Studies with Folic Acid Analogues. MERLE K. LOKEN, Ph.D., KIM S. YOUNG, M.D., DON G. MOSSER, M.D., and JAMES F. MARVIN, Ph.D.

Potentiation of X-ray Effects by Actinomycin D. G. J. D'ANGIO, M.D., SIDNEY FARBER, M.D., and CHARLOTTE L. MADDOCK, M.D.

Modification of Late Radiation Change with L-Triiodothyronine. ARVIN S. GLICKSMAN, M.D., RULON W. RAWSON, M.D., and JAMES J. NICKSON, M.D.

SECTION AB: 2:00-4:30 P.M.

RADIATION HAZARDS—FACT OR FANCY

Prepared by Laurence L. Robbins, M.D., Presiding

The Radiologist Looks at Radiation Hazards. PAUL HODGES, M.D.

The Government Looks at Radiation Hazards. CLINTON POWELL, M.D.

The Physicist Looks at Radiation Hazards. E. W. WEBSTER, Ph.D.

A Survey of Patients Receiving Previous Thymic Radiation. L. SNEGIREFF, M.D.

Genetic Effects in Children and Grandchildren of Women Treated for Infertility and Sterility by X-ray Therapy. A Report of a Study of Thirty-Two Years. IRA I. KAPLAN, M.D.

A Geneticist Looks at the Radiation Hazard. WILLIAM J. SCHULL, Ph.D.

BUSINESS MEETING: 4:30 P.M.

Wednesday, November 19

SECTION A: 10:30 A.M.-12:30 P.M.

CINEFLUOROGRAPHY IN MEDICAL PRACTICE

Prepared by Herbert Stauffer, M.D., Presiding

Current Technical Problems in Cinefluorography. LEE B. LUSTED, M.D.

Cinefluorography Employing Split Image Television Type Image Amplifiers. PAUL C. HODGES, M.D., and ROBERT D. MOSELEY, JR., M.D.

An Approach to Biplane Cineangiocardiology. HERBERT L. ABRAMS, M.D.

Technical Factors in Selective Cinecardioangiography. J. A. CAMPBELL, M.D., PAUL LURIE, M.D., and EUGENE KLATTE, M.D.

Functional Roentgenology of the Urinary System: Urethral Vesicle Relationships in Voluntary and Involuntary Urination. THEODORE A. TRISTAN, M.D., JOHN A. BENJAMIN, M.D., and JAMES S. WATSON, JR., M.D.

Cinefluorographic Study of Pharyngeal Function Related to Speech. JOHN A. KIRKPATRICK, JR., M.D., and RICHARD W. OLMSTED, M.D.

Cinefluorography in Practice. EARL R. MILLER, M.D.

SECTION B: 10:30 A.M.-12:30 P.M.

RADIOLOGICAL PHYSICS

Harald H. Rossi, Ph.D., Presiding

Limited Survey of Radiation Exposure from Medical Fluoroscopes. ROBERT O. GORSON, M.S., and JESSE LIEBERMAN, M.S.

Comparison of the Use of Standard Depth Dose Data at 250 Kvp and 2 MEV by Direct Measurement of Tumor Exposure Dose in Vivo. PETER WOOTTON, B.S., and SIMEON T. CANTRIL, M.D.

Measurement of Penumbra in Cobalt 60 and Supervoltage Machines Using a Photographic Method. Evaluation and Results. LEONARD STANTON, M.S.

Distribution of Electric Charge in Electron-Irradiated Tissue. J. S. LAUGHLIN, Ph.D., H. A. ASTARITA, B.A., J. G. REISINGER, B.S., and M. DANZKER, M.A.

Microradiography and Micro-Dosimetry of Human Bone Burdened with Ra²²⁶. R. E. ROWLAND, M.S., J. H. MARSHALL, Ph.D., and J. JOWSEY, Ph.D.

SECTION AB: 2:00-5:00 P.M.

Theodore J. Wachowski, M.D., Chairman of Board of Directors, Presiding

Roentgenology Clinic: Basic Principles in the Diagnosis of Chest Diseases. Moderator: BENJAMIN FELSON,

M.D. Panel: FELIX FLEISCHNER, M.D., JOHN R. McDONALD, M.D., COLEMAN RABIN, M.D.

Renal Morphology as an Indication of Kidney Disease. C. J. HODSON, M.D., F.R.C.P., F.F.R., London, England

The Seminal Vesicles in Health and Disease. ROY GREENING, M.D., PAUL LEBERMAN, M.D., and PHILIP J. HODES, M.D.

The Radiologic Differential Diagnosis of Abdominal Trauma. J. H. WOODRUFF, JR., M.D., R. E. OTTOMAN, M.D., and J. H. SIMONTON, M.D.

Staphylococcus Pneumonia in Infants and Adults. HARVEY I. MEYERS, M.D., and GEORGE JACOBSON, M.D.

Unusual Loculated Pleural Effusion Following Super-voltage Radiation for Breast Carcinoma. ARNOLD BACHMAN, M.D., and KEVIN MACKEN, M.D.

SECTION C: 2:00-5:00 P.M.

RECENT ADVANCES IN RADIOLOGIC PHYSICS

H. O. Wyckoff, Ph.D., Presiding

This program is arranged only a few weeks before the meeting, and details are therefore not available for publication here.

Thursday, November 20

SECTION A: 10:30 A.M.-12:30 P.M.

RESEARCH IN PROGRESS

Everett L. Pirkey, M.D., Third Vice-President, Presiding

Diagnosis of Pericardial Effusion with Intracardiac Carbon Dioxide. JAMES H. SCATLIFF, M.D., ALFRED J. KUMMER, M.D., and ARNOLD H. JANZEN, M.D.

WEDGE PULMONARY ARTERIOGRAPHY: Application in Congenital and Acquired Heart Disease. A. L. LOOMIS BELL, JR., M.D., HERBERT HEMPEL, M.D., SEIICHI SHIMOMURA, M.D., and J. A. TAYLOR, JR., M.D.

Contrast Visualization During Induced Cardiac Arrest. CHARLES T. DOTTER, M.D., LOUIS H. FRISCHE, M.D., and WILLIAM S. HOSKINSON, M.D.

Coarctation of the Pulmonary Artery (Clinical and Experimental Observations). KARL H. FALKENBACH, M.D., NORMAN ZHEUTLIN, M.D., and BERNARD J. O'LOUGHLIN, M.D.

Diagnosis of Esophageal Varices by a New Radiological Method: A Preliminary Report. M. H. NATHAN, M.D.

The Use of Barium and Bismuth Suspensions in Bronchography. S. W. NELSON, M.D., WILLIAM MOLNAR, M.D., and A. CHRISTOFORIDIS, M.D.

An Evaluation of the Pharmacological Hazards Resulting from Use of "Visciodol" in Bronchography. PHILIP M. JOHNSON, M.D., and GEORGE L. IRWIN, M.D.

A Preliminary Investigation of Radioisotopic Zinc and Manganese as Pancreatropic Agents. I. MESCHAN

M.D., J. L. QUIN, M.D., RICHARD L. WITCOFSKI, M.D., and PETER BARAM, M.D.

Combined Copper and Aluminum Filtration in Radiography. LEWIS E. ETTER, M.D., ADOLPH G. KAMMER, M.D., JOHN A. DATTOLI, M.D., HERMAN CEMBER, M.S., and LAWRENCE C. CROSS, R.T.

SECTION B: 10:30 A.M.-12:30 P.M.

Lauriston S. Taylor, A.B., Presiding

Report on 1958 Meetings of International Commission on Radiological Units and Measurements. HAROLD O. WYCKOFF, Ph.D.

Design of Free-Air Ionization Chambers for the Soft X-ray Region (20-100 kv). VICTOR H. RITZ, B.S.

Design of Sensitive Non-Directional Condenser Ionization Chambers for Low Energy X-rays. ROSS GARRETT, M.S.

Fluorod Radiation Dosimetry. MORRIS HODARA, M.S., MILTON FRIEDMAN, M.D., and GERALD J. HINE, Ph.D.

Some Experiences with Silver-Activated Phosphate Glass Dosimeters in Phantoms. H. MERMAGEN.

SECTION AB: 2:00-4:30 P.M.

Charles M. Gray, M.D., Presiding

The Treatment of Carcinoma of the Lower Lip. J. A. DEL REGATO, M.D., and JOSE M. SALA, M.D.

Radical Preoperative Roentgen Therapy in the Treatment of Primarily Inoperable Advanced Cancers of the Head and Neck. FRANZ J. BUSCHKE, M.D., and MAURICE E. GALANTE, M.D.

Supervoltage (2 MEV) Rotation Irradiation for Cancer of the Urinary Bladder. MILTON FRIEDMAN, M.D.

Evaluation of Five Years Experience of Supervoltage Irradiation in Bladder Carcinoma. PHILIP RUBIN, M.D., and ROBERT BURAN, M.D.

Observations on Radiological Anatomy of the Esophagogastric Junction. ALAN S. JOHNSTONE, M.D., Professor of Radiodiagnosis, University of Leeds, England

Segmental Colitis. RICHARD H. MARSHAK, M.D., BERNARD S. WOLF, M.D., and JOAN ELIASOPH, M.D.

Some Migratory Aspects of Inflammatory Collections of Pancreatic Origin. MAXWELL H. POPPEL, M.D.

BUSINESS MEETING: 4:30 P.M.

THE CARMAN LECTURE: 8:15 P.M.

Carcinoma of the Stomach

Owen H. Wangensteen, M.D.

Professor of Surgery, University of Minnesota Medical School

Presentation of the Gold Medal of the Society

Presentation of Certificates

Announcement of the Scientific Awards

Induction of New Officers

Presentation of the Pfahler Gavel

Friday, November 21

SECTION A: 10:30 A.M.-1:00 P.M.

SYMPOSIUM ON CARDIOVASCULAR ROENTGEN DIAGNOSIS

Ivan J. Miller, M.D., Presiding

An Experimental Study of the Bronchial and Pulmonary Arteries. WILLIAM H. SPRUNT, M.D., RICHARD M. PETERS, M.D., and DAVID L. HOLDER, B.S.

Congenital Pulmonary Arterial Stenosis. MELVIN M. FIGLEY, M.D., AARON M. STERN, M.D., NORMAN TALNER M.D., and HERBERT E. SLOAN, M.D.

Radiologic Signs of Pericardial Effusion: An Experimental Study. HARRY Z. MELLINS, M.D., PETER KOTTMEIER, M.D., and BRIAN KIELY, M.D.

Suprasternal Thoracic Aortography. J. STAUFFER LEHMAN, M.D., WILLIAM M. LEMMON, M.D., RANDAL A. BOYER, M.D., and EDWARD A. FITCH, M.D.

Radiologic Evaluation of Ventricular Septal Defects After Surgical Closure. EDWARD B. SINGLETON, M.D., DENTON A. COOLEY, M.D., DAN G. McNAMARA, M.D., and PAUL M. CHAU, M.D.

The Relationship of the Cardiac Silhouette to Altered Respiratory Dynamics in Congenital Heart Disease. LAWRENCE A. DAVIS, M.D., and MARGARET VERMILLION, M.D.

Rheumatic Heart Disease: Usefulness of Lateral View in Determining Presence of Left Ventricular Hypertrophy. WILLIAM R. EYLER, M.D., DAVID L. WAYNE, M.D., and JOHN E. RODENBAUGH, M.D.

SECTION AB: 10:30 A.M.-1:00 P.M.

James W. J. Carpender, M.D., Second Vice-President, Presiding

Early Observations on 70-MEV Radiation Therapy. ROBERT S. STONE, M.D., GAIL D. ADAMS, Ph.D., and ROSE V. LOUIE, M.D.

Clinical Experience with High-Speed Electrons in Cancer Therapy. ERICH M. UHLMANN, M.D.

Pulmonary Radiation Reaction—A Physiological and Time-Dose Study. J. R. GISH, M.D., E. O. COATES, Jr., M.D., LUCILLE DuSAULT, A.B., and HOWARD P. DOUB, M.D.

The Treatment of Bronchogenic Carcinoma with Conventional X-rays According to a Specific Time Dose Pattern. SIDNEY RUBENFELD, M.D., and GUSTAVE KAPLAN, M.D.

Clinical Evaluation of the Use of Radioactive Chrome Phosphate in the Control of Pleural and Ascitic Effusions Due to Malignant Neoplasms. C. R. PERRYMAN, M.D., EDWARD J. PAVSEK, M.D., and JOHN D. McALLISTER, M.D.

Concerning the Blood Supply to the Kidney. C. J. HODSON, M.D., F.R.C.P., F.F.R., London, England

Radiographic Findings in Renal Vein Thrombosis. NORMAN ZHEUTLIN, M.D., DIXON HUGHES, M.D., and B. J. O'LOUGHLIN, M.D.

Important Discrepancies Between Excretory Pyelography and Integral Kidney Function Tests in Young Hypertensives. LUCY FRANK SQUIRE, M.D., and JORGEN U. SCHLEGEL, M.D.

REFRESHER COURSES: POSTGRADUATE INSTRUCTION

The 1958 Refresher Course Series will be presented during the Forty-fourth Annual Meeting of the Radiological Society of North America at the Palmer House, Chicago, Ill. This year is the Twentieth Anniversary of the Refresher Courses. In the beginning the enrollment was very small. Now, many courses are attended by several hundred. Registration for the meeting will begin at 1:00 P.M., Saturday, Nov. 15. On Sunday, Nov. 16, the registration desk will be open at 9:00 A.M., and it will be open at 8:00 A.M., Monday through Friday. Please register early. The courses will start at 2:00 P.M., Sunday, Nov. 16. This session will be followed by a second course from 4:30 to 5:30 P.M., and the Film Reading Session at 8:00 P.M.

On Monday, Nov. 17, there will be a series of Refresher Courses beginning at 8:30 A.M. and continuing until 10:00 A.M., with a second series from 10:30 A.M. until noon. The remainder of the week the Refresher Course period will be from 8:30 to 10:00 A.M. No other meeting will be scheduled during the hours in which the Refresher Courses are conducted. Attendance is limited to the medical profession, including graduate students and residents in radiology; radiation physicists, radiobiologists, chemists and others closely concerned with the science of radiology; and medical students certified by the deans of their respective medical schools.

A registration fee of \$15.00, which includes the Refresher Course fee, must be paid by all nonmembers of the Radiological Society of North America at the time of registration at the Palmer House. The exceptions are guest speakers, guest

instructors, scientific exhibitors, residents or fellows in radiology, medical students, trainees in physics, and officers in the Armed Forces of the United States on temporary duty and away from their practice. Members of the Radiological Society of North America do not pay a registration fee or a Refresher Course fee. All are required to register at the R.S.N.A. registration desk in the Palmer House. Admission to the Refresher Courses will be by presentation of the registration badge and a ticket for the particular Course, except Courses 1, 2, and 3 on Sunday. Admission to these Courses will be by badge only. Payment of the registration fee by nonmembers is *not* to accompany the request for tickets but is to be paid when the tickets are called for at the registration desk. If you cannot use the tickets you have reserved, please notify the Chairman of the Refresher Course Committee.

Read the description of the Courses, noting particularly the days that they are offered, and make your selection for the day. Turn to the colored insert, indicate thereon your first, second, and third preferences, and mail the order blank promptly. The number attending each course will be limited by the seating capacity of the room. The requests for tickets will be filled in chronological order. You will be notified regarding your selection.

After you have gone over these courses, we would appreciate suggestions for future courses, as well as for new instructors for some of the present ones. Please put these suggestions on a card and leave it at the registration desk at the time you pick up your tickets, or mail it to the Chairman at the time you make your request.

Course No. 1: Sunday, 2:00-4:00 P.M.

Therapy Information Session

VINCENT P. COLLINS, M.D., Houston, Texas
Moderator

J. W. J. CARPENDER, M.D., Chicago, Ill.
ROBERT ROBBINS, M.D., Philadelphia, Penna.
THEODORE P. EBERHARD, M.D., Ann Arbor, Mich.
M. M. KLIGERMAN, M.D., New York, N. Y.

A series of selected cases will be presented depicting the clinical course of the lesion, the pathology, and the results.

Only histologically proved cases will be used.

Course No. 2: Sunday, 4:30-5:30 P.M.

Therapy Charts and Records

MILFORD D. SCHULZ, M.D., Belmont, Mass.
and

JOHN HALE, Ph.D., Philadelphia, Penna.

An ideal radiation therapy chart has been under study for years. In the past eighteen months a

Committee of the R.S.N.A. has been intensively studying the subject, and has designed a therapy record which will be presented at this session.

Course No. 3: Sunday, 8:00-10:00 P.M.

Film Interpretation Session

L. HENRY GARLAND, M.B., San Francisco, Calif.
Moderator

WENDELL G. SCOTT, M.D., St. Louis, Mo.
BERNARD J. O'LOUGHLIN, M.D., Los Angeles, Calif.
ALFRED S. BERNE, M.D., Syracuse, N. Y.

This session is a diagnostic symposium designed to illustrate basic principles of film interpretation, including differential diagnosis. Only proved cases will be shown, and all will be diagnosable either from the films, the history, the fluoroscopic findings, or a combination of these data.

The cases will be chosen largely from material submitted by members of the Pacific Roentgen Society. However, any member of the Radiological Society who desires to present an instructive

case may submit his material to the Moderator, Dr. L. Henry Garland, 450 Sutter St., San Francisco 8, Calif.

Course No. 4:

Monday, 8:30 A.M.-10:00 A.M.

Treatment of Pelvic Cancer

MANUEL GARCIA, M.D.
New Orleans, La.

WALTER T. MURPHY, M.D.
Buffalo, N. Y.

A greater portion of the first period will be devoted to radiation treatment of cancers of the cervix uteri. The second period will cover treatment of cancer of the corpus and its appendages.

(This course continued Tuesday, Course No. 20)

Course No. 5: Monday, 8:30-10:00 A.M.

Translumbar Aorto-Arteriography

GEORGE D. DAVIS, M.D.
Rochester, Minn.

The aims, technical problems, and various methods of aortography and femoral arteriography via the aorta will be reviewed. More emphasis will be placed on the study of vascular occlusive disease than on renal artery study. The technic and results of the method currently employed at the instructor's institution will be reviewed in detail. Stress will be placed on the importance of visualizing the femoral arteries during aortography, and a method of accomplishing this will be presented. Correlation between the roentgenologic appearances, functional impairment, and surgical considerations will be discussed.

Course No. 6: Monday, 8:30-10:00 A.M.

Some Fundamentals in Chest Roentgen Interpretation

BENJAMIN FELSON, M.D.
Cincinnati, Ohio

Chest roentgen interpretation should not merely represent an attempt to correlate particular shadows with specific diseases but should be approached with an understanding of the basic principles of anatomy, physiology, pathology, and radiology involved. Some of these principles will be considered and their practical application illustrated.

Period I

1. A method of fluoroscopy
2. The "silhouette" sign
3. The air bronchogram

Period II

1. Anatomic variations in the pulmonary fissures
2. Lobar collapse
3. Lobar enlargement
4. The disrupted fissure

(This course continued Tuesday, Course No. 22)

Course No. 7: Monday, 8:30-10:00 A.M.

Respiratory Distress of the Newborn and Infant

GEORGE JACOBSON, M.D., and

VICTOR G. MIKITY, M.D.
Los Angeles, Calif.

Roentgenological examination and interpretation in the infant and newborn have often been perplexing. This course will deal with some of the problems of the child with respiratory distress.

Course No. 8: Monday, 8:30-10:00 A.M.

Fundamental Considerations in Radiation Biology

TITUS C. EVANS, Ph.D.
Iowa City, Iowa

The following topics will be considered:

1. Mechanisms of radiation injury as seen in the cell, the tissue, the organism and the offspring.
2. Variations in effects related to changes in quantity or quality of radiation.
3. Variation in radiosensitivity of tissues.
4. Modification of radiation reactions.
5. Effects of protraction and fractionation.
6. Aplasia and neoplasia.

Possible relationships of these biologic factors to certain problems in radiation therapy, protection, and public health will be discussed.

Course No. 9: Monday, 8:30-10:00 A.M.

Roentgenologic Aspects of Systemic Lupus Erythematosus

DAVID M. GOULD, M.D.
Little Rock, Ark.

The radiological signs and patterns of systemic lupus erythematosus and related diseases will be discussed along with the differential diagnosis.

Course No. 10: Monday, 8:30-10:00 A.M.

Basic Radiation Dosimetry

HAROLD O. WYCKOFF, Ph.D.
Washington, D. C.

The text for this course is the 1956 Recommendations of the International Commission of Radiological Units and Measurements.¹ Any pertinent discussions of the September 1958 ICRU meeting will be included. The difference between the exposure dose in roentgens, the absorbed dose in rads, and the RBE dose in rems will be pointed out. Data on energy dependence and rate dependence of r-meters will be presented, and suggestions will be made on methods for checking the reproducibility of such instruments. Direct measurement of the absorbed dose by calorimetric means will be discussed, but the principal method considered will be computation of absorbed dose from ionization measurements.

¹ National Bureau of Standards Handbook 62.

Course No. 11: Monday, 8:30-10:00 A.M.**Electron Spin Resonance****M. S. BLOIS, Ph.D., Stanford, Calif.**

The principles of electron spin spectroscopy will be discussed. The application of this tool to the study of radiation effects on biological and chemical systems will be presented.

Course No. 12: Monday, 10:30-12:00 A.M.**Radiology of Congenital Heart Disease****JOHN A. CAMPBELL, M.D., and
EUGENE C. KLATTE, M.D.
Indianapolis, Ind.**

The advent of successful open heart surgery has changed the importance of roentgen diagnosis of congenital heart disease from a matter of academic interest to one of practical necessity. The roentgenologist serves several key functions in the diagnosis of the lesions. It is frequently his original fluoroscopic and plain film interpretations which lead to the recognition of these malformations, and distinguish those requiring more specialized diagnostic studies. As a member of the hospital cardiology team, the radiologist provides an indispensable service by performing selective cardioangiographic procedures which yield precise information about the altered morphology and hemodynamics.

This course will present the plain film and cardioangiographic diagnosis of the common types of congenital heart disease. Cineradiographic studies will be used to illustrate the pathologic anatomy and physiology of the different conditions. The differential diagnosis of those lesions producing similar clinical features will be emphasized.

Period I

1. Basic considerations in roentgen diagnosis.
2. Patent ductus arteriosus.
3. Ventricular septal defect.
4. Atrial septal defect.
5. Anomalous pulmonary venous return.

Period II

1. Coarctation of aorta.
2. Fibroelastosis and myocardial disease.
3. Pulmonary stenosis.
4. Tetralogy of Fallot.
5. Tricuspid atresia.
6. Truncus arteriosus.
7. Transposition of great vessels.
8. Miscellaneous.

(This course continued Tuesday, Course No. 21)

Course No. 13: Monday, 10:30-12:00 A.M.**Implications of Oxygen Tension Control in Radiation Therapy****C. SANGER, R.C.S., New York, N. Y.**

The basis for using oxygen to modify biological response to radiation will be discussed briefly.

Details of the practical application of oxygen tension will be described together with some discussion of results.

Course No. 14: Monday, 10:30-12:00 A.M.**Roentgenographic Diagnosis of Pulmonary Embolism****FELIX G. FLEISCHNER, M.D.
Boston, Mass.**

The roentgen signs of pulmonary embolism will be discussed and a differential diagnosis given.

Course No. 15: Monday, 10:30-12:00 A.M.**Treatment Planning in Rotation Therapy****M. M. KLIGERMAN, M.D.
New York, N. Y.
V. G. DeCASTRO, B.S.
New Haven, Conn.**

This course will concern itself with the problem of determination of dose at points within or at the surface of an irregular volume, when the relative motion of the volume with respect to a beam of radiation is one of rotation.

The procedure for dose determination should be generally applicable, accurate, simple to use, and quick. The use of standard isodose charts, available in any radiotherapy department, allows calculation of dose at points continuously irradiated within the volume and at points in the volume that receive radiation during only part of the rotation time.

The possibilities of the use of rotation will be presented with examples of the calculations, and material will be distributed to the persons taking the course for practice in working out the dose distributions. The calculated values will be compared with experimental values obtained for the same set of factors, as well as with dose distributions obtained using other methods of calculation.

Course No. 16: Monday, 10:30-12:00 A.M.**Diagnostic Applications of Radioactive Isotopes****J. P. STORAASLI, M.D., and J. S. KROHMER, M.A.
Cleveland, Ohio**

The most common diagnostic uses of radioactive isotopes will be discussed. The isotopes to be covered are I^{131} (iodide, serum albumin, rose bengal), Cr^{51} , P^{32} , Au^{198} , and Co^{60} . The physical requirements as well as the physiopathological criteria for the various clinical applications will be included.

The diagnostic applications to be discussed are:

1. Thyroid function studies including uptakes, clearance rates, PBI's, and TSH test.
2. Circulation studies, including blood volume, cardiac output, liver flow, and peripheral vascular studies.
3. Body scanning, including thyroid, liver, and blood pools.

PLAN OF PRESENTATION

Sunday, Nov. 16 2:00-4:00 P.M.	Monday, Nov. 17 8:30-10:00 A.M.	Tuesday, Nov. 18 8:30-10:00 A.M.
1. Therapy Information Session Vincent P. Collins, M.D., Moderator J. W. J. Carpenter, M.D. Robert Robbins, M.D. Theodore P. Eberhard, M.D. M. M. Kligerman, M.D. 4:30-5:30 P.M.	4. Treatment of Pelvic Cancer (To be continued Tuesday) Manuel Garcia, M.D. Walter T. Murphy, M.D. 5. Translumbar Aorto-Arteriography George D. Davis, M.D. 6. Some Fundamentals in Chest Roentgen Interpretation (To be continued Tuesday) Benjamin Felson, M.D. 7. Respiratory Distress of the Newborn and Infant George Jacobson, M.D. Victor G. Mikity, M.D. 8. Fundamental Considerations in Radiation Biology Titus C. Evans, Ph.D. 9. Roentgenologic Aspects of Systemic Lupus Erythematosus David M. Gould, M.D. 10. Basic Radiation Dosimetry Harold O. Wyckoff, Ph.D.	20. Treatment of Pelvic Cancer (Continued) Manuel Garcia, M.D. Walter T. Murphy, M.D. 21. Radiology of Congenital Heart Disease (Continued) John A. Campbell, M.D. Eugene C. Klatte, M.D. 22. Some Fundamentals in Chest Roentgen Interpretation (Continued) Benjamin Felson, M.D. 23. Dosage in Internal Use of Radium and Other Radioisotopes as Discrete Sources Elizabeth F. Focht, B.A. 24. Roentgen Evaluation of Bone Tumors Gwilym S. Lodwick, M.D. 25. Basic Electronics for Radiologists (To be continued Wednesday) Louis H. Frische, M.D. Charles T. Dotter, M.D. 26. Treatment Planning with High Energy Radiation (Particularly Telecobalt) Lucille A. DuSault, A.B. Robert J. Bloor, M.D. 27. The Small Intestine (Continued) Richard H. Marshak, M.D.
2. Therapy Charts and Records Milford D. Schulz, M.D. John Hale, Ph.D. 8:00-10:00 P.M.	12. Radiology of Congenital Heart Disease (To be continued Tuesday) John A. Campbell, M.D. Eugene C. Klatte, M.D. 13. Implications of Oxygen Tension Control in Radiation Therapy C. Sanger, R.C.S. 14. Roentgenographic Diagnosis of Pulmonary Embolism Felix G. Fleischner, M.D. 15. Treatment Planning in Radiation Therapy M. M. Kligerman, M.D. V. G. DeCastro, B.S. 16. Diagnostic Applications of Radioisotopes I. P. Skoraasli, M.D. J. S. Krohmer, M.A. 17. Radiotherapy of Carcinoma of the Larynx Juan A. del Regato, M.D.	
3. Film Interpretation Session L. Henry Garland, M.B., Moderator Wendell G. Scott, M.D. Bernard J. O'Loughlin, M.D. Alfred S. Berne, M.D.	18. Radium Therapy John D. Reeves, M.D. 19. The Small Intestine (To be continued Tuesday) Richard H. Marshak, M.D.	

Wednesday, Nov. 19 8:30-10:00 A.M.	Thursday, Nov. 20 8:30-10:00 A.M.	Friday, Nov. 21 8:30-10:00 A.M.
28. Examination of the Colon C. Gianturco, M.D.	36. Examination of the Gastrointestinal Tract in Infants and Children Lawrence A. Davis, M.D.	44. Treatment Planning and Therapy with the 70-MEV Synchrotron G. D. Adams, Ph.D. R. S. Stone, M.D.
29. Professional Liability Problems William J. McAuliffe, Jr. (Attorney)	37. Neuroradiology (To be continued Friday) Alfred L. Schmitz, M.D.	45. Neuroradiology (Continued) Alfred L. Schmitz, M.D.
30. Radiology of the Larynx and Pharynx (To be continued Thursday) Arnold L. Bachman, M.D.	38. Radiology of the Larynx and Pharynx (Continued) Arnold L. Bachman, M.D.	46. Radiation Exposure and Protection with Various Diagnostic Procedures M. L. Meurk, B.S. R. S. Sherman, M.D.
31. Common Causes of Radiation Hazards Carl B. Braestrup, B.S., P.E. Theodore P. Eberhard, M.D.	39. Genetic Effects of Radiation W. L. Russell, Ph.D.	47. Practical Techniques in Pediatric Radiology Lawrence A. Davis, M.D.
32. Treatment Planning: Conventional Energy X-rays A. Raventos, M.D. J. Hale, Ph.D.	40. Important Considerations in X-Ray Demonstration and Diagnosis of Fractures Kenneth D. A. Allen, M.D. John H. Freed, M.D.	48. Therapeutic Applications of Radioactive Isotopes Eugene L. Saenger, M.D., Moderator J. P. Storaasli, M.D. H. B. Elkins, M.D. R. Robbins, M.D.
33. Basic Electronics for Radiologists (Continued) Louis H. Frische, M.D. Charles T. Dotter, M.D.	41. Therapeutic Uses of Radioisotopes W. K. Sinclair, Ph.D.	49. Design and Equipment of Radioisotope Laboratories G. W. Morgan
34. The Statistical Point of View Harold Tivey, M.D.	42. Mediastinal Masses (To be continued Friday) Ted F. Leigh, M.D. H. Stephen Weens, M.D.	50. Mediastinal Masses (Continued) Ted F. Leigh, M.D. H. Stephen Weens, M.D.
35. Irradiation Therapies for Carcinoma of the Urinary Bladder J. R. Maxfield, Jr., M.D.	43. Radiotherapy of Carcinoma of the Skin Juan A. del Regato, M.D.	

4. P^{32} in the diagnosis of intraocular tumors.
5. Metabolic studies including pancreatic insufficiency studies and assay of "intrinsic factor."

Course No. 17: Monday, 10:30-12:00 A.M.**Radiotherapy of Carcinoma of the Larynx**

JUAN A. DEL REGATO, M.D.
Colorado Springs, Colo.

A plan of radiotherapy will be given for cancer of the larynx. It will be shown how the technic must vary when the perilaryngeal structures are involved.

Course No. 18: Monday, 10:30-12:00 A.M.**Radium Therapy**

JOHN D. REEVES, M.D.
Boston, Mass.

Following an informal review of clinical and physical fundamentals in surface, interstitial, and intracavitary radium therapy, a variety of illustrative cases will be presented in brief detail with discussion of treatment and sample calculations of radium dosimetry. Examples of the usefulness of tantalum-182 wire, gold-198 grains, and cobalt-60 sources in "radium-substitute" therapy will be included. The usefulness of radium and cobalt in "bomb" form will be considered.

The comparative advantages and disadvantages of 400-kv to 2,000-kv x-ray therapy will be discussed in some cases.

An attempt will be made to interrelate some radiotherapeutic philosophies of Great Britain, Scandinavia, and Texas with some in this country.

Among other data, a progressive set of clinical radium problems, each covering one of the Paterson-Parker rules and with one method of solution, will be distributed. Discussion will be welcomed.

Course No. 19: Monday, 10:30-12:00 A.M.**The Small Intestine**

RICHARD H. MARSHAK, M.D.
New York, N. Y.

Part I

1. Technic, including a discussion of the various barium preparations.
2. Concepts of small intestinal patterns.
3. The malabsorption syndrome. Sprue, lymphosarcoma and Whipple's disease.
4. Problems in the interpretation of functional changes.
5. Barium studies in small intestine obstruction.

Part II

1. Regional enteritis.
2. Infarction of the small bowel.
3. Tumors.
4. Miscellaneous disorders including scleroderma, amyloidosis, allergy.

(The course continued Tuesday, Course No. 27)

Course No. 20: Tuesday, 8:30-10:00 A.M.**Treatment of Pelvic Cancer**

MANUEL GARCIA, M.D.
New Orleans, La.

WALTER T. MURPHY, M.D.
Buffalo, N. Y.

(Continued from Monday, Course No. 4)

Course No. 21: Tuesday, 8:30-10:00 A.M.**Radiology of Congenital Heart Disease**

JOHN A. CAMPBELL, M.D., and
EUGENE C. KLATTE, M.D.
Indianapolis, Ind.

(Continued from Monday, Course No. 12)

Course No. 22: Tuesday, 8:30-10:00 A.M.**Some Fundamentals in Chest Roentgen Interpretation**

BENJAMIN FELSON, M.D.
Cincinnati, Ohio

(Continued from Monday, Course No. 6)

Course No. 23: Tuesday, 8:30-10:00 A.M.**Dosage in Internal Use of Radium and Other Radioisotopes as Discrete Sources**

ELIZABETH F. FOCHT, B.A., New York, N. Y.

The principles and technics of dosage calculations in the use of discrete sources for intracavitary or interstitial therapy are similar for all gamma-emitting isotopes. This course will concentrate on discrete gamma sources, with emphasis as follows: The fundamentals of amount, exposure, filter, distribution, and resultant dose will be discussed for these sources in general. Different systems of radium-dosage evaluation and their recent modifications will be analyzed and adapted to the use of such isotopes as cobalt, gold, iridium, etc., including consideration of the time factor.

Three-dimensional models of some actual seed, needle, and tube distributions will be shown with their radiographs, and the processes of making them will be summarized. Methods of calculation from the radiographs or from the models will be explained.

An outline of the subject will be given with references, which should constitute a survey of information available—and philosophies—to date.

Course No. 24: Tuesday, 8:30-10:00 A.M.**Roentgen Evaluation of Bone Tumors: Relationship of Bone Destruction and Proliferation to Tumor Behavior**

GWILYM S. LODWICK, M.D., Columbia, Mo.

The purpose of this course is to provide a roentgenologic basis for predicting tumor behavior and a

rational treatment of bone neoplasms. Survival statistics based upon a detailed analysis of roentgenograms from 1,221 cases will be presented. Those attending are invited to bring films.

Course No. 25: Tuesday, 8:30-10:00 A.M.

Basic Electronics for Radiologists

LOUIS H. FRISCHE, M.D., and
CHARLES T. DOTTER, M.D.
Portland, Ore.

Electronic complexities have made appraisal of modern equipment increasingly difficult for the practicing radiologist, beleaguered as he is by other professional responsibilities. The objective of this course, therefore, is to review elementary principles, emphasizing everyday radiological applications. Operation of power supply, simple vacuum tubes, electronic switches, and similar devices will be discussed, supplemented by practical demonstration.

(This course continued Wednesday, Course No. 33)

Course No. 26: Tuesday, 8:30-10:00 A.M.

Treatment Planning with High Energy Radiation (Particularly Telecobalt)

LUCILLE A. DU SAULT, A.B., and
ROBERT J. BLOOR, M.D.
Detroit, Mich.

Treatment planning with high energy radiation involves different problems from treatment planning with conventional x-ray. Differences in source size, diaphragm position, treatment distance, as well as energy, in high energy equipment, produce variations in surface, depth, and exit doses, and penumbra. This course will discuss the differences in dose distribution resulting from these factors for various combinations of fields, and the adjustments which must be made in treatment plans because of them. Plans for various tumor locations will be presented and choice of plan for specific clinical problems will be discussed.

Anyone who would like to hear a particular problem discussed may write in advance to Miss DuSault, Henry Ford Hospital, Detroit 2, Mich.

Course No. 27: Tuesday, 8:30-10:00 A.M.

The Small Intestine

RICHARD H. MARSHAK, M.D., New York, N. Y.

(Continued from Monday, Course No. 19)

Course No. 28: Wednesday, 8:30-10:00 A.M.

Examination of the Colon

C. GIANTURCO, M.D.
Urbana, Ill.

Various methods of arriving at an accurate diagnosis of lesions of the colon will be discussed. Some pitfalls in colon examination will be shown.

Course No. 29: Wednesday, 8:30-10:00 A.M.

Professional Liability Problems

WILLIAM J. McAULIFFE, JR., Attorney
Chicago, Ill.

During the past few years the American Medical Association has conducted an extensive survey and study of all phases of malpractice and medicolegal suits. A large volume of data and material has been gathered. Some phases of these suits will be reviewed to show how they were initiated and how they could have been circumvented.

Course No. 30: Wednesday, 8:30-10:00 A.M.

Radiology of the Larynx and Pharynx

ARNOLD L. BACHMAN, M.D.
New York, N. Y.

The course will cover the radiographic anatomy and physiology of the larynx, radiology of laryngeal paralysis, radiology of normal and abnormal swallowing patterns, tumors of the larynx and pharynx, demonstration of extension of laryngopharyngeal tumors. In addition, certain benign conditions will be discussed, including foreign bodies in the cervical esophagus, cricopharyngeal spasm, and radiology of the adenoids.

(This course continued Thursday, Course No. 38)

Course No. 31: Wednesday, 8:30-10:00 A.M.

Common Causes of Radiation Hazards

CARL B. BRAESTRUP, B.S., P.E.
New York, N. Y.

and

THEODORE P. EBERHARD, M.D.
Ann Arbor, Mich.

The hazards associated with the medical use of roentgen rays and with teletherapy may be minimized by the use of properly constructed equipment, ample room shielding, and, most important, appropriate operating procedures. These factors will be discussed from the point of view of the safety of the patient, staff, and public. The subject will be further subdivided into fluoroscopy, radiography, and teletherapy, with emphasis upon the necessary safeguards of each application.

Course No. 32: Wednesday, 8:30-10:00 A.M.

Treatment Planning: Conventional Energy X-rays

A. RAVENTOS, M.D., and J. HALE, Ph.D.
Philadelphia, Penna.

X-rays generated at 250 kilovolts or less are very useful in the treatment of superficial lesions and also many deep lesions. Realization of the full potentialities of conventional x-ray therapy often requires

Careful treatment planning based upon a good practical knowledge of the physical principles involved.

In this course the basic principles of treatment planning will be discussed, and some of the methods that have proved useful will be outlined. Some clinical examples requiring the use of very low, intermediate, and 250-kv x-ray beams will be discussed in detail.

Course No. 33: Wednesday, 8:30-10:00 A.M.

Basic Electronics for Radiologists

LOUIS H. FRISCHE, M.D., and
CHARLES T. DOTTER, M.D.
Portland, Ore.

(Continued from Tuesday, Course No. 25)

Course No. 34: Wednesday, 8:30-10:00 A.M.

The Statistical Point of View

HAROLD TIVEY, M.D.
Houston, Texas

The purpose of this course is to review, in a non-mathematical fashion, those statistical methods which are in current use or are available for evaluating the effects of therapy, or for the presentation of results of diagnostic studies.

Emphasis will be given to some logical and statistical pitfalls which combine to produce a well deserved skepticism of "statistics." Examples will be presented of some newer statistical methods which are more efficient for summarizing data, that is, which discard less hard-earned information than those now generally used. These methods will also produce a usable result of known reliability with shorter follow-up than the commonly employed techniques.

This is a survey course, but notes and a bibliography will be supplied those interested in further study.

Course No. 35: Wednesday, 8:30-10:00 A.M.

Irradiation Therapies for Carcinoma of the Urinary Bladder

J. R. MAXFIELD, JR., M.D.
Dallas, Texas

This course will seek to evaluate the different types of malignant change found in the urinary bladder, together with the choice of treatment best suited for the type of tumor and extent of involvement. An effort will be made to point out the merits and limitations of the various methods of irradiation. The excellent results with interstitial cobalt in nylon in certain infiltrating carcinomas of the bladder will be considered. Experience with these techniques and impressions of the results achieved will be discussed.

Course No. 36: Thursday, 8:30-10:00 A.M.

The Examination of the Gastrointestinal Tract in Infants and Children

LAWRENCE A. DAVIS, M.D.
Louisville, Ky.

Examination of the gastrointestinal tract in infants and younger children is difficult only in the technical problems involved. Actually, the range of abnormality is limited and does not compare with the complexity of disease found in the adult. This course will stress these technical problems, and offer suggestions for their solution by the radiologist and one technician. The various congenital and acquired diseases found in pediatric practice will be analyzed, and the use of water-soluble opaque media discussed.

Course No. 37: Thursday, 8:30-10:00 A.M.

Neuroradiology

ALFRED L. SCHMITZ, M.D.
San Francisco, Calif.

Bone changes in meningiomas, acoustic nerve tumors, and sellar tumors will be discussed. The technique and the normal roentgen anatomy in fractional encephalography will be illustrated. Normal encephalograms will be compared with those showing changes in the ventricular system and cisterns secondary to tumor pathology. Cerebral arteriograms will be presented to augment the encephalographic studies.

(This course continued Friday, Course No. 45)

Course No. 38: Thursday, 8:30-10:00 A.M.

Radiology of the Larynx and Pharynx

ARNOLD L. BACHMAN, M.D.
New York, N. Y.

(Continued from Wednesday, Course No. 30)

Course No. 39: Thursday, 8:30-10:00 A.M.

Genetic Effects of Radiation

W. L. RUSSELL, Ph.D.
Oak Ridge, Tenn.

The following subjects will be considered: general information on genes and mutation; radiation-induced gene mutations and chromosomal aberrations, importance of the cell stage in gametogenesis at which mutations are induced; mutation rates in fruit fly, mouse and man; variation in mutation rates within a species; evidence that the genetic effects of radiation are cumulative; the shape of the curve for mutation rate and dose; comparison of spontaneous and radiation-induced mutations; the "rate-doubling dose" concept and its limitations; recessive and dominant mutations; the spectrum of

effects of radiation-induced mutations; the high frequency of recessive lethal mutations and their time of killing; the increasing evidence of the importance of mutations with some dominant effects; the fate of mutations in the population; mutation, selection and evolution; recent evidence on damage in the first generation offspring of irradiated parents; summary of estimates of genetic hazards of radiation; the reports of the genetics committees of the U. S. National Academy of Sciences and the British Medical Research Council, the National Committee on Radiation Protection, the International Committee on Radiation Protection, and the United Nations Scientific Committee; the research activities of the Atomic Energy Commission; general responsibility for controlling exposure to radiation; estimates of the gonad doses of radiation from various sources; the special responsibilities of the medical profession.

Course No. 40: Thursday, 8:30-10:00 A.M.

Important Considerations in the X-Ray Demonstration and Diagnosis of Fractures with Some Unusual Examples

KENNETH D. A. ALLEN, M.D., and
JOHN H. FREED, M.D.
Denver, Colo.

A brief discussion of technic and the various routine and special radiographic projections required to achieve a high accuracy in the radiographic demonstration and diagnosis of fractures will be presented, with numerous case illustrations. Examples illustrating problems in differential diagnosis, importance of follow-up examinations, management of complications, and interesting and unusual fractures will be shown. Comments will be made on methods of reporting fractures, advising and consulting with the referring physician, and avoiding medicolegal complications.

Course No. 41: Thursday, 8:30-10:00 A.M.

Therapeutic Uses of Radioisotopes

W. K. SINCLAIR, Ph.D.
Houston, Texas

Successful therapeutic use of radioisotopes depends on the deposition of a suitable amount of energy at the diseased site, with the minimum dissipation of energy elsewhere. This involves concentration of the radioactive material at the site in question, which may be achieved in a number of ways:

- I. By metabolic accumulation of the isotope.
- II. By the physical nature of the material (colloid).
- III. By deliberate localization of specific sources.

I is limited to the use of radioiodine for thyroid disorders and, to a lesser extent, some other isotopes, such as phosphorus 32.

II includes the use of radioactive colloids, particularly gold 198 and chromic phosphate.

Under III, there are three main divisions: *intracavitary*, particularly in the bladder with solutions or point sources of cobalt 60, bromine 82, and gold 198; *interstitial*, which includes the use of needles, wires, and seeds of gold 198, tantalum 182, iridium 192, cesium 137, cobalt 60, and others; *superficial*, which includes some gamma-ray emitters such as tantalum-182 wire in the eye, but is concerned mainly with the application of beta emitters, phosphorus 32, and the plaques and shells of strontium 90 for the treatment of superficial lesions.

Each of these various applications will be reviewed with special reference to the dosimetry involved and with emphasis on group III.

Course No. 42: Thursday, 8:30-10:00 A.M.

Mediastinal Masses

TED F. LEIGH, M.D., and H. STEPHEN WEENS, M.D.
Atlanta, Ga.

1. Anatomy and physiology of the mediastinum.
2. Tumors—of the thymus, thyroid, parathyroids, esophagus, peripheral nervous system, fat, lymph nodes, bone and cartilage, and others; teratomas, germinal tumors, mesotheliomas, mesenchymomas; tumors of blood vascular origin, and tumors of lymph vascular origin.
3. Cysts—bronchogenic, of digestive tract, pericardial, celomic and inflammatory, thymic, parasitic, and others.
4. Aneurysms—of the aorta, pulmonary artery, other arteries, and the veins.
5. Miscellaneous lesions—abscesses, diaphragmatic herniations, meningoceles, paramediastinal pulmonary lesions, and others.

(This course continued Friday, Course No. 50)

Course No. 43: Thursday, 8:30-10:00 A.M.

Radiotherapy of Carcinoma of the Skin

JUAN A. DEL REGATO, M.D.
Colorado Springs, Colo.

Although cell sensitivity may account for a small percentage of failures in treatment of carcinoma of the skin, most failures are due to the selection of improper technic. A plan of treatment for various skin lesions will be given.

Course No. 44: Friday, 8:30-10:00 A.M.

Treatment Planning and Therapy with the 70-MEV Synchrotron

G. D. ADAMS, Ph.D., and R. S. STONE, M.D.
San Francisco, Calif.

Part I: General principles of planning radiation treatments will be reviewed. As a necessary part,

the role played by the quantities "exposure" and "absorbed dose" will be included. A clear distinction will be drawn between these quantities.

These principles will be illustrated for two specific radiation qualities: (1) conventional 250-kvp x-rays and (2) 70-MEV x-rays. The high energy x-rays in the present instance are generated by a 70-MEV synchrotron, and some salient characteristics of the x-ray beam which it produces are discussed. The method used to achieve an absorbed dose calibration for 70-MEV x-rays will be outlined.

The conventional and the high-energy x-ray beams will be compared both as to isodose charts obtainable and as to similarity of method used to determine the overall plan. Some limitations of each quality will appear automatically.

Part II: Some clinical impressions gained from over two years experience in the application of the 70-MEV x-ray beam to patients will be reviewed. Illustrative cases will be presented.

Course No. 45: Friday, 8:30-10:00 A.M.

Neuroradiology

ALFRED L. SCHMITZ, M.D.
San Francisco, Calif.

(Continued from Thursday, Course No. 37)

Course No. 46: Friday, 8:30-10:00 A.M.

Radiation Exposure and Protection with Various Diagnostic Procedures

M. L. MEURK, B.S., and R. S. SHERMAN, M.D.
New York, N. Y.

A review of the radiation safety recommendations and requirements for diagnostic radiological installations will be presented, including methods for minimizing the dose to patients and to radiological personnel. The range of dose in various portions of the body, including the gonads, obtained with different diagnostic techniques, will be discussed on the basis of measurements made by the instructors and those reported in the literature.

Course No. 47: Friday, 8:30-10:00 A.M.

Practical Technics in Pediatric Radiology

LAWRENCE A. DAVIS, M.D.
Louisville, Ky.

The various technics successfully used in radiography and fluoroscopy will be demonstrated and discussed. Stress will be placed on simplicity and on radiation protection. The technics used in gastro-

intestinal examinations, excretory, urography, and cardiac fluoroscopy will be detailed.

Course No. 48: Friday, 8:30-10:00 A.M.

Therapeutic Applications of Radioactive Isotopes

EUGENE L. SAENGER, M.D., Cincinnati, Ohio
Moderator

J. P. STORAASLI, M.D., Cleveland, Ohio

H. B. ELKINS, M.D., Iowa City, Iowa

R. ROBBINS, M.D., Philadelphia, Penna.

This course, an informal discussion of specific clinical therapeutic problems by a panel of men experienced in the use of radioisotopes, will be guided by questions from the audience, whose active participation is encouraged.

Individuals who have particularly interesting or difficult cases which will be of value to the group are invited to submit pertinent information to the Moderator, Eugene L. Saenger, M.D., Radioisotope Laboratory, General Hospital, Cincinnati 29, Ohio, in advance of the meeting so that slides may be prepared to facilitate the discussion.

Course No. 49: Friday, 8:30-10:00 A.M.

Design and Equipment of Radioisotope Laboratories

G. W. MORGAN
Washington, D. C.

Practical aspects of the design and equipment of medical radioisotope laboratories will be discussed, with suggested facilities for different programs utilizing various radioisotopes. Prototype laboratories and facilities will be presented for both diagnostic and therapeutic programs. A review will be made of laboratories for use of radioisotopes purchased in a form standardized and ready for use as well as for hospitals procuring their isotopes directly from Atomic Energy Commission facilities. The discussion will also include facilities and equipment for private practitioners and typical hospital programs, as well as the more extensive programs involving animal experimentation.

Course No. 50: Friday, 8:30-10:00 A.M.

Mediastinal Masses

TED F. LEIGH, M.D., and H. STEPHEN WEENS, M.D.
Atlanta, Ga.

(Continued from Thursday, Course No. 42)

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Intracranial Complications of Leukemia in Children. Margaret P. Sullivan. *Pediatrics* 20: 757-780, November 1957. (M. D. Anderson Hospital and Tumor Institute, Houston, Texas)

The author was able to find in the English literature, prior to the advent of chemotherapy, 9 cases of leukemia with meningeal involvement, only 1 of which was in a child. Since the employment of chemotherapy, 6 reports have appeared describing symptoms attributable to infiltration of the meninges in children. Seven additional cases in patients ranging in age from twenty-one months to twelve years are presented in this paper.

The symptoms of intracranial leukemic involvement include irritability, headache, vomiting, and meningismus. Less commonly increase in appetite, obesity, hypertension, and various neurologic abnormalities have been observed. Papilledema appears to be a constant finding and has been attributed by some investigators to infiltration of the optic nerve and sheath. Roentgenograms of the skull usually show separation of the suture lines, and such separation may be decreased following irradiation. [Direct leukemic infiltration of the cranial vault adjacent to the sutures is not considered by the author, and separation of the sutures has been accepted as *prima facie* evidence of increased intracranial pressure.—R. S. O.] Spinal fluid findings which are mentioned are elevation of pressure [unreliable in children], a high protein content, increased cell count, and decrease in concentration of sugar.

The most effective treatment for the intracranial complications of leukemia is roentgen therapy to the entire skull. Usually 250 to 500 r given in seven to ten days will bring about improvement in the symptoms and the spinal fluid without adversely affecting the course of the disease in general. Oral administration of adrenal steroid hormones may also be effective if resistance to this type of therapy has not developed.

Eight roentgenograms; 3 photomicrographs; 5 photographs; 4 graphs; 1 table.

ROBERT S. ORMOND, M.D.
Dearborn, Mich.

Familial Fibrous Swelling of the Jaws. Report of a Case. William Hogan and Edwin J. Lieberman. *J. Pediat.* 51: 554-563, November 1957. (University of Illinois, Research and Educational Hospitals, Chicago)

A case of familial fibrous swelling of the jaws, in an 11-year-old Negro boy, is reported. This is believed to be the eleventh such case to be recorded. The authors' patient exhibited all the characteristic features of this unusual condition with the exception of a positive family history. The diagnosis was confirmed by the typical roentgen appearance and by biopsy.

Two roentgenograms; 3 photomicrographs; 1 photograph.

Tomography of the Petrous Bone in Cases of Suspected Cholesteatoma. H. Etter. *Radiol. clin.* 26: 334-343, November 1957. (In German) (Röntgenabteilung Kantonsspitals Luzern, Switzerland)

When cholesteatoma is suspected, the author recommends tomography, with a frontal cut through the external meatus. The patient lies on his back, with his head flexed so that the eye-ear line forms a 50 to 60°

angle opening caudally and ventrally. This view shows both the external and internal meatus, the tympanum, the epitympanic recess, and the antrum. It is of especial value in demonstrating the roof of the external auditory meatus and the portion of the antrum lying above it. Several examples of the normal and abnormal are given. The technic is simple and easily reproduced because the patient lies symmetrically upon his back.

Nine roentgenograms; 4 photographs.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

The Occlusal Film. An Adjunct to the Roentgen Diagnosis of Nasal Fractures. Ralph J. Caparosa and Albert R. Zavatsky. *Arch. Otolaryng.* 66: 503-511, November 1957. (406 Bessemer Bldg., Pittsburgh, Penna.)

Usually the diagnosis of a nasal fracture is readily made from the patient's history and physical examination. The authors, however, recommend x-ray studies in every case to delineate the nature of the fracture and as a prerequisite to satisfactory treatment. The occlusal view is thought to be the best to demonstrate lateral or mesial displacement of fractured nasal bones. X-rays are projected from a cephalad source after a bite film has been placed in the patient's mouth between the occlusal surfaces. Actually the central ray is directed through the nasal bones in a tangential plane drawn from the midfrontal prominence to the upper incisors and in such a manner as to prevent superimposition upon the soft-tissue shadow of the lip.

Roentgenograms are reproduced to illustrate the value of the occlusal view.

Fifteen roentgenograms; 11 drawings.

THE CHEST

Miniature Chest X-Rays on Admission to Hospital. An Evaluation of a System. D. A. Symers. *Brit. J. Radiol.* 30: 602-605, November 1957. (Diagnostic Radiological Department, St. Mary's Hospital, London, W. 2, England)

The author presents his evaluation of a system for obtaining miniature chest films on admission to hospitals. Of 1,690 patients examined, 20 per cent showed some abnormality. It is concluded that, provided certain basic points are met, a miniature chest x-ray scheme for hospital admissions is to be commended on both medical and financial grounds.

From a medical point of view, it is justifiable for the following reasons:

(1) It provides information leading to early diagnosis of unsuspected disease. This may save or prolong the patient's life or advantageously alter the mode of treatment.

(2) By early detection and segregation of cases of tuberculosis, it provides some extra degree of protection from infection for other patients and for the nursing, medical, and domestic staffs.

(3) The pick-up rate in this relatively small series is slightly greater than that of mass miniature radiography, presumably due to "selection," i.e., those requiring hospital in-patient treatment with all that this implies.

(4) It provides a permanent record of the appearances of the chest. In many hospitals, due to lack of space, it is necessary to dispose of x-ray films after a relatively short time. If, however, the miniature film is kept with the patient's notes, it is available, for comparison, as long as the notes are kept, which is usually for many years.

Financially miniature chest films on hospital admission are probably justifiable for the following reasons:

(1) They reduce greatly the number of large films of the chest requested in a routine manner.

(2) The equipment may be utilized for more general radiology when the department is overloaded.

(3) If the patient's eventual stay in the hospital is appreciably shortened, the saving is obviously great.

The basic points which, it is felt, should be met before the scheme is to be commended are as follows:

(1) The equipment should be housed in its own room with cubicles and with a separate dark room and, preferably, office-viewing room.

(2) Both the equipment and the services of the staff attached to it should be fully utilized. The method by which this is attained will vary from hospital to hospital. However, it has been confirmed recently that the greatest pick-up rate occurs in patients referred from general practitioners, which is a strong argument in favor of including this group, if local circumstances permit.

(3) Whatever the system used, it is important that the reported films should reach the ward shortly after the patient is admitted, otherwise much of their value may be lost. Furthermore, in "urgent" cases a system of insuring that the physician or surgeon concerned is informed personally and without delay is essential.

(4) Periodic checks of relatively small "sample" admissions should be analyzed to determine whether or not the required standard of efficiency is being maintained.

In addition to the above basic points it is obviously desirable to have a special unit in the hospital able to accept, investigate and, if necessary, treat the cases of suspected tuberculosis detected by the scheme.

Two tables. THEODORE E. KEATS, M.D.
University of Missouri

Pulmonary Cryptococcosis. Sam J. Kuykendall, F. Henry Ellis, Jr., Lyle A. Weed, and F. Edmund Donoghue. *New England J. Med.* 257: 1009-1016, Nov. 21, 1957. (Mayo Foundation, Rochester, Minn.)

The authors report 4 cases of cryptococcosis with lesions confined to the lungs and the hilar nodes. Cryptococcosis, or torulosis, may occur as an acute, subacute, or chronic infection. The respiratory tract is probably the site of entry of the organisms, which are thought to be air-borne from a reservoir in the soil. Following the establishment of the infection, there is a tendency to dissemination to various parts of the body, particularly the brain and meninges, in which case a fatal outcome may be expected.

When the disease is limited to the lungs, symptoms may be absent. When present, they are nonspecific, including cough, scanty mucoid sputum with or without blood, fever, malaise, and possibly pain and loss of weight. Males are more frequently affected than females. The x-ray findings are variable. The common early lesion is a circumscribed patch of consolidation of moderate density. Cavitation and calcification rarely occur. There is a predilection for the lower lobes.

In the early stages, involvement of the hilar lymph nodes is uncommon. Lesions may be single or multiple. At times there is a resemblance to miliary tuberculosis. As the disease progresses and becomes more widespread, it may resemble a diffuse bilateral bronchopneumonia. The differential diagnosis lies between neoplasm, tuberculosis, and other mycotic infections. Though the causative organism may be isolated from the body secretions, the diagnosis is usually made at surgical exploration.

The course is usually slowly progressive. Death from isolated pulmonary manifestations is unusual, if indeed it has ever occurred. The only definitive form of therapy is surgery, with a good chance for a permanent cure if the disease is treated early enough.

Five roentgenograms; 7 photomicrographs; 1 photograph; 1 table.

PAUL MASSIK, M.D.
Quincy, Mass.

Bronchiectasis and Acute Pneumonia. William Ruberman, Irving Shaffer, and Thomas Biondo. *Am. Rev. Tuberc.* 76: 761-769, November 1957. (W. R., 1143 DeKalb Ave., Brooklyn 23, N. Y.)

Bronchiectasis occurring in adults following acute pneumonia was studied by means of bronchograms obtained more than one month following the cessation of clinical evidence of activity of the pneumonia. Furthermore, bronchography was not done until roentgen evidence of residual disease had been stable for at least three weeks. Out of a total of 69 patients in this category, 29 were found to have significant bronchiectasis. One had an abnormal bronchogram which on a repeat study was found to have returned to normal. Repeat bronchograms were done on 24 patients at least eight weeks following the initial examination.

A second group of 29 patients with a history suggesting chronic bronchiectasis, or roentgenographic findings indicative of this disease, was also examined. Seven of these patients had asthma and chronic cough; of these, 6 were negative and 1 had bronchiectasis. Of the remaining 18, 5 were found to have bronchiectasis.

Of the postpneumonic group, 27 had bronchiectasis at the site of pneumonia and 7 of these had additional sites of pneumonia without bronchiectasis. The remaining 2 patients had bronchiectasis in areas which had not been involved by the recent infection.

There was no essential difference in the past history of patients with and without bronchiectasis in the post-pneumonic group, but the duration of the pneumonia was significant. An average of sixteen days was found in a group of 100 consecutive pneumonia patients, while in the group with bronchiectasis the duration of the evidence of pneumonia was two months. The group with bronchiectasis tended to have persistent râles, produce sputum, and maintain fever longer than the patients without bronchiectasis. Only 1 patient had a definite return to normal of bronchiectatic segments in the eight-week follow-up study. This suggests that reversible bronchiectasis is not common in adults.

It is not entirely clear from this study whether the bronchiectasis was present before the pneumonia and led to the prolonged course of the disease or whether the bronchiectasis was caused by the pneumonia. A definite conclusion is not warranted, but in view of the absence of respiratory symptoms prior to the pneumonia in the patients with bronchiectasis, it is reasonable to say that it is possible that the bronchiectasis was the result of the acute infection. Since only one of the

patients with bronchial asthma and chronic cough had bronchiectasis, the authors conclude that bronchiectasis is rarely an inciting factor in bronchial asthma.

In 5 additional cases of bronchiectasis which were found in the group of patients with symptoms and signs suggesting the disease, roentgenographic evidence of bronchopulmonary involvement was present on the plain film. A normal chest roentgenogram does not, however, exclude bronchiectasis.

Five tables.

JOHN H. JUHL, M.D.
University of Wisconsin

The Radiological Differential Diagnosis of Unilateral Total Pulmonary Veiling. George Cohen. South African M. J. 31: 1186-1189, Nov. 23, 1957. (Johannesburg General Hospital, Johannesburg, Union of South Africa)

An increase in density throughout one lung field seen on a postero-anterior roentgenogram of the chest is always relative, *i.e.*, relative to the transradiance of the opposite lung field. The increase may be real or apparent. An apparent increase in density on one side may result from a relative decrease in density on the opposite side.

Among the radiographic causes of unilateral total pulmonary veiling are poor positioning and radiographic "fog" and artefacts. Poor positioning is easily recognized by measuring the distance from the sternal end of the clavicle to the center of the vertebral column; the side with the longest measurement is always the more translucent. The presence of "fog" and artefacts is obvious.

A unilateral increase in lung density may be due to the following extrathoracic causes: (1) the greater development of the pectoral and upper chest wall muscles of right-handed or left-handed individuals, on the respective side; (2) mastectomy, producing increased transradiance of the lung fields on the operated side; (3) lesions producing an increased "bulk" or volume of the chest wall, *e.g.*, cellulitis, tumors or abscesses, hematomas; (4) poliomyelitis or any other condition accompanied by wasting of the muscles of the thoracic cage, resulting in increased translucency on the affected side.

Intrathoracic causes of unilateral pulmonary veiling include pleural effusion, pneumonia, pulmonary embolus, pleural thickening, fixity of the diaphragmatic leaf, emphysema, pulmonary edema, fibrosis of one lung field, large pneumothoraces, massive collapse of a lung.

More unusual conditions, such as penetrating stab wounds, may be responsible for increased lung density. A careful and detailed radiological analysis, however, will almost always result in an accurate diagnosis.

Eight roentgenograms.

Pulmonary and Osseous Eosinophilic Granuloma. Report of a Case. John R. Williams, William O. Pischnotte, Billy P. Sammons, and Martin F. Sokoloff. New England J. Med. 257: 1082-1084, Nov. 28, 1957. (U. S. Naval Hospital, St. Albans, N. Y.)

A single case of eosinophilic granuloma involving bone and lungs, with pathological proof of both lesions, is reported. This entity was first described in 1954 (May, Garfinkle, and Dugan: *Ann. Int. Med.* 40: 549, 1954. *Abst. in Radiology* 64: 135, 1955) and a few cases have been published since that time.

The authors' patient was a 21-year-old male who first

experienced pain in the left humerus. X-ray examination and biopsy showed an eosinophilic granuloma. Six months later pulmonary symptoms developed, and a biopsy three months after this revealed eosinophilic granuloma of the lung. The pulmonary lesion was demonstrable as a bilateral diffuse nodularity of the parenchyma. In the bones there was an osteolytic area with no bony reaction around it. Clinically the patient complained of cough, weight loss, anorexia, and low-grade fever. Biopsy was followed by improvement without specific therapy.

Three roentgenograms; 2 photomicrographs.

PAUL MASSIK, M.D.
Quincy, Mass.

Intralobar Bronchopulmonary Sequestration. Review of Literature and a Case Report. Newman L. Stephens. J. Indian M. A. 29: 309-313, Oct. 10, 1957. (Clara Swain Hospital, Bareilly, India)

The author presents what he believes to be the first case of intralobar bronchopulmonary sequestration to be reported in India and about the one-hundredth case to be recorded in the literature. His patient was a 15-year-old Hindu boy, with a history of fever and cough with expectoration in recurring bouts since the age of eight. The picture was that characteristic of intralobar bronchopulmonary sequestration, including absence of mediastinal shift and of clubbing of the nails. A roentgenogram of the chest showed exaggeration of the bronchovascular markings, especially in the midlung field, off the right hilus, and a cystic area about 4 cm. in diameter at the right base just above the dome of the diaphragm. On bronchoscopy the bronchial tree appeared normal. Bronchography revealed good filling of the main bronchi without any filling defect (right lung). No oil entered the cystic area, giving the impression of a blocked bronchus. There was no evidence of bronchiectasis. A segmental resection of the right lower lobe was performed. An anomalous artery the size of the common carotid was found leading to the cystic segment. The histologic diagnosis was congenital cyst of the lung. No other congenital defects were found.

Knowing that cystic changes (bronchiectasis, fibrosis, and emphysema) occur early in children suffering from fibrocystic disease of the pancreas, xanthomatosis, tuberous sclerosis of the lungs, and pulmonary scleroderma, it can be inferred that the developmental deficiency in all these conditions may be a true hypoplasia, because of inherent weakness or because of autonomic dysfunction resulting in disturbances of blood supply and of myoelastic bronchial function. These would produce changes in the lung during early life at a time when new and susceptible bronchial bud generations are still developing. In the author's opinion, it is likely that what takes place in a more generalized fashion in the conditions mentioned above may occur in a localized fashion in sequestered lobes of the lung.

Two roentgenograms; 1 photomicrograph; 2 tables.

Roentgen Symptoms of Lymph Node Rupture into a Bronchus, with a Report on Two Cases of Bronchial Perforation in Lymphogranulomatosis. H. Anacker. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 87: 588-597, November 1957. (In German) (Röntgenabteilung der Chirurg. Univ.-Klinik, Giessen, Germany)

Twenty-three cases of lymph-node perforation into a bronchus in a total of 28 bronchial lesions are reported. The right and left bronchial trees were involved in a

ratio of 20 to 7; one lesion was centrally located at the carina. The cases are not classified as to etiology, but it is evident that the majority lesions were due to tuberculosis. Two were attributable to lymphogranulomatosis (Hodgkin's).

Methods of demonstration are bronchography and tomography, supplemented by bronchoscopy. The radiographic signs are: (1) stenosis or occlusion of the bronchus, with or without calcification, which may be distal, lateral, or intraluminal; (2) occlusion of a bronchus, with a fistula into the lymph node; (3) a tumor within the bronchus. The most frequent combination of signs (in 11 of the 23 cases) was subtotal bronchostenosis with atelectasis near a calcific nodule. Tomography may demonstrate the intraluminal location of the calcification if it is axial to the stenosis. If perforation of the lymph nodes is incomplete, the calcification will be found slightly lateral to the bronchus with an impression upon the bronchial contour. The latter, for the most part, requires "aimed" bronchography of the individual bronchus for demonstration. In the presence of multiple lymph nodes, stenosis combined with complete obstruction is characteristic. In such cases differentiation from bronchogenic carcinoma is impossible radiographically unless there is demonstration of a normal intermediate segment between the area of narrowing and complete occlusion. Bronchial occlusion with a fistula into the lymph nodes also requires "aimed" bronchography for demonstration. A small fistulous tract or a small cavity within a paratracheal or parabrachial lymph node are characteristic for tuberculosis or anthracosis. Direct demonstration of an intraluminal lymph node "tumor" is unusual.

Perforation of lymphogranulomatous lymph nodes into the bronchus is a rare complication of Hodgkin's disease. Two cases are reported, with bronchostenosis and atelectasis. These signs disappeared after x-ray therapy.

Seventeen roentgenograms; 2 photographs; 1 drawing; 2 tables.

G. A. DOEHNER, M.D.

St. Vincent's Hospital, N. Y.

Anatomic and Pathologic Studies of the Thoracic Duct. Harvey W. Kausel, Thomas S. Reeve, Arthur A. Stein, Ralph D. Alley, and Allan Stranahan. *J. Thoracic Surg.* 34: 631-641, November 1957. (Albany Medical College, Albany, N. Y.)

The authors report a study carried out in an effort to clear up points of confusion concerning the anatomy and pathology of the thoracic duct system. In 50 cadavers the thoracic duct was cannulated just above the diaphragm and injected with 50 per cent sodium iodide solution. Radiographs were then made, following which the ducts were injected with methylene blue and removed by dissection. Serial sections from the duct walls were also studied microscopically.

The cisternae chyli were found to be generally globular in shape, about 4 by 3 cm. in diameter, and overlying the spine somewhere between the tenth dorsal and third lumbar vertebra. The duct was single in about one-third of cases and branched into 2 or more trunks in the low dorsal or mid-dorsal regions in most of the remainder. Valve leaflets were present at intervals along the ducts and were generally competent, preventing retrograde injection of dye in all of 10 cases in which it was attempted. Drainage was left-sided, into the jugular-subclavian veins in all but 1 case.

Histologically the thoracic ducts were found to have

more muscular walls than veins of similar size, but with rather poor definition of layers. There was a rich supply of small capillaries to the duct walls. The intimal surface of the lumen was smooth and white, and the walls were elastic.

After reviewing the embryology of the thoracic duct system, the authors conclude that the anatomic variations encountered are not secondary to inflammation or neoplasm, but rather are due to aberrations of embryonic development. In none of the cases were inflammatory changes or cystic dilatations found. A type of sclerosis was observed in a few of the ducts resembling that sometimes seen in the peripheral veins of the aged. No atheromatous changes were seen, although the duct transports about 70 per cent of the absorbed fat from the intestinal tract. The authors feel that, if atherosclerosis does occur, it must be rare.

Secondary involvement of the thoracic duct by metastatic tumor is discussed. Direct extension through the duct wall is believed unlikely, and entry is thought to occur through small lymph channels in the periductal areolar tissue. The authors do not believe that mechanical obstruction of the duct produces chylous effusions, but think rather that chylothorax or chylous ascites results from perforation, tearing, or erosion of the duct walls as a consequence of malignant invasion.

Four roentgenograms; 5 photomicrographs; 1 photograph; 1 diagram.

DON E. MATTHIESEN, M.D.

Phoenix, Ariz.

Pathogenesis of Mediastinal Emphysema Complicating Therapeutic Pneumoperitoneum. William Weiss. *Am. Rev. Tuberc.* 76: 897-898, November 1957. (Philadelphia General Hospital, Philadelphia 4, Penna.)

Mediastinal emphysema is a rare complication of therapeutic pneumoperitoneum. A number of theories have been postulated as to the mechanism by which the emphysema arises. Two cases are reported in which roentgenograms showed air in the anterior abdominal wall extending along fascial planes upward into the thorax to produce the emphysema in the mediastinum. This confirms earlier reports of a similar mechanism. The author states that he has observed 2 other patients in whom the air in the anterior abdominal wall was visible in lateral roentgenograms.

Two roentgenograms.

JOHN H. JUHL, M.D.

University of Wisconsin

Mediastinal Lipoma. J. F. Alden, R. B. G. Bjornson, E. R. Sterner, and J. L. Sprafka. *Dis. of Chest* 32: 580-581, November 1957. (Bethesda Hospital, St. Paul, Minn.)

A short case history is given of a 49-year-old male who had an annoying cough for five years. A roentgenographic examination revealed a large mediastinal mass with anterior displacement of the trachea. The mass was excised; grossly and histopathologically it was a lipoma. Recovery was uneventful.

Two roentgenograms.

HENRY K. TAYLOR, M.D.

New York, N. Y.

Mediastinal Herniation and Displacement Studied by Transversal Tomography. H. Lodin. *Acta radiol.* 48: 337-350, November 1957. (Roentgen Department, University Hospital, Uppsala, Sweden)

The author has studied the problem of mediastinal displacement and herniation by using transverse to-

mography. Certain "weak spots" in the mediastinum have been described. These are as follows: (1) in the anterior mediastinum at the level of the first three to four costal cartilages—the thymic area—limited ventrally by the sternum and dorsally by the great vessels; (2) in the posterosuperior mediastinum at the level of the third to the fifth thoracic vertebra, limited anteriorly by the esophagus, trachea, and great vessels, and posteriorly by the vertebral column; (3) in the postero-inferior mediastinum at the level of the fifth to eleventh thoracic vertebra, limited anteriorly by the heart and great vessels, and posteriorly by the aorta and vertebral column. These three areas are separated only by loose connective tissue.

Distinction is made between mediastinal herniation and mediastinal displacement. Herniation has occurred when "a portion of the mediastinal pleura on one side has penetrated through the mediastinum and invaginated a portion of the opposite pleural cavity." Mediastinal displacement occurs when the entire mediastinum is displaced and may exist in conjunction with herniation.

A Plexiglas model was made of the mediastinal structures, each of the parts being removable, so that the influence of the different elements could be examined separately. Thin sheets of Plexiglas represented the septa. Film studies of this model were obtained for initial study. Clinical examinations were performed under the same conditions. The apparatus used was a Pantix Strator (Zuder, Genoa) with a focus-object distance of about 250 cm., an object-film distance of about 50 cm., an angle incidence of 25°, and no grid. Standard cassettes with ordinary double screens were employed. Sections were taken at approximately 2 to 3 cm.

From a study of the Plexiglas model, it was determined that visualization of the septum was intimately dependent on its position as well as the size of the supervening structures; the septum must lie outside of the sagittal plane passing through the outer contours of the structures. Because of this fact, the postero-inferior mediastinal septum is the most difficult to visualize due to the size of the overlying heart shadow.

Examinations were done on 20 normal subjects, half between twenty and twenty-five years of age and half between eleven and twelve years, with no pulmonary disease. The anterior septum was discernible in 19 of the 20 cases, being parallel with the sternum in 12. In the remaining 8 cases it was either slightly displaced to one side or the other or deviated slightly in its course. The upper posterior septum was discernible in 9 of the 20 cases and in 8 of these 9 cases it lay in the midline. The lower posterior septum was seen in only 2 cases.

Case histories, with film studies, are presented of 3 patients having pulmonary tuberculosis, who, during the course of the disease, showed evidence of mediastinal displacement or anterior herniation.

Fourteen roentgenograms; 1 photograph; 3 diagrams.

L. B. LEINBACH, M.D.
Bowman Gray School of Medicine

Partial Air Replacement During Thoracentesis: Its Value in Diagnosis and Treatment. Richard H. Meade. *Dis. of Chest* 32: 529-533, November 1957. (1810 Wealthy St., S. E., Grand Rapids 6, Mich.)

The author stresses the value of partial air replacement of fluid removed from the pleural cavity. He would like to see its practice expanded, particularly be-

cause of its usefulness in the roentgen visualization of shadows otherwise obscured by fluid.

The procedure should be used in all cases of pleural effusion but, where there is an empyema or hemothorax, it is important not to allow any air to remain in the pleural cavity. Roentgenograms are reproduced to show pleural metastases after partial air replacement of an extensive pleural effusion.

HENRY K. TAYLOR, M.D.
New York, N. Y.

THE HEART AND BLOOD VESSELS

Congenital Ducto-Pulmonary Atresia: A Variant of Pulmonary Atresia of Some Clinical Importance. M. I. Powell and H. G. Hiller. *M. J. Australia* 2: 684-686, Nov. 9, 1957. (Royal Children's Hospital, Melbourne, Australia)

The authors use the term congenital ducto-pulmonary atresia as a substitute designation for what is commonly known as pseudotruncus arteriosus. It will be remembered that in the true persistent truncus arteriosus there is a single large outflow tract from the heart, from which arise the right and left pulmonary arteries as well as the systemic vessels, the innominate, carotid, and subclavian arteries. In the so-called pseudotruncus there is, in fact, a main pulmonary artery formed separately from the aorta (*i.e.*, the primitive aorta-pulmonary septum has actually formed); but this artery is atretic at some point and does not actually communicate with the right ventricle. More peripherally, the right and left pulmonary arteries are patent, but the only practical means of blood supply to the lungs is by grossly enlarged bronchial arteries from the aorta, anastomosing with the pulmonary system in the hilar region. It is the clinical and theoretical aspects of this condition which the authors discuss.

The symptoms are relatively mild; the patients do quite well and show only minimal dyspnea and fair exercise tolerance. Cyanosis is mild and at times barely perceptible. Examination of the heart reveals little of specific nature, and the precordium is notably free from bruits in most cases; well out in the lung fields, usually maximal in one or sometimes both axillae, is a well marked continuous bruit, audible at birth. This bruit is not maximum in the ductus area. Combined with the cyanosis, it forms a striking diagnostic feature. Blood pressures are normal. The electrocardiogram shows a right ventricular hypertrophy.

The radiological findings are considered unique and diagnostic. The most important is an increased vascularity of the lung fields, seldom observed in uncomplicated cyanotic congenital heart disease, once the infant age is passed. It usually denotes transposition of great vessels or a reversed shunt associated with pulmonary hypertension. However, the congestive changes seen in the lesion under discussion in no way resemble the anatomical architecture of engorged pulmonary arteries and are in fact attributable to the enormously enlarged bronchial arteries. The nodular appearance of these vessels is particularly well seen in the upper zones of the lung.

The second important feature is the cardiac contour, which is probably one of the few contours reasonably pathognomonic of the underlying heart lesion. This appearance is produced by a markedly elevated apex, denoting a huge hypertrophied right ventricle, an enormous ascending aorta, and often a right-sided aortic

arch. In the series of 20 patients cited, 14 showed this right-sided arch, which is a striking phenomenon.

Other important features include the absence of normal pulmonary arteries as shown in the anteroposterior and right anterior oblique projections, which is explained by the basic anatomy of the lesion. The use of a barium bolus may demonstrate indentations of the esophagus due to the huge bronchial arteries.

Eleven of the authors' patients had an angiocardio-graphic examination, and in all cases this has been typical. The huge aorta overlying both ventricles has filled at once from the right ventricle, and in most cases the bronchial arteries can be seen arising from this. Often an insignificant right ventricular outflow tract or infundibulum dwindling away to nothing can be seen, especially in the right anterior oblique position. Special mention is made of the size of the ascending aorta, the diameter of which is often three times that of the descending aorta.

It is thought that angiocardiology in this condition is a more useful investigation than cardiac catheterization. In the one case in which a catheter was passed, the oxygen tension showed a rise, high in the right ventricle, and the right ventricular pressure was equal to the systemic pressure.

The differential diagnosis is from an arteriovenous aneurysm of the lung, which is eliminated by x-ray findings, or a tetralogy of Fallot with an open ductus arteriosus, but here the continuous murmur is in the ductus area and the radiological features are different.

Treatment is conservative as a rule, because of the relative well-being of the patients.

Three roentgenograms; 3 diagrams.

THEODORE E. KEATS, M.D.
University of Missouri

Calcification of the Ascending Aorta. Jack Lester and C. E. Gudbjerg. *Acta radiol.* 48: 351-354, November 1957. (Roentgen Department, Rigshospitalet, Copenhagen, Denmark)

The authors review the literature concerning calcification of the ascending aorta and its association with syphilis and report a study of 200 chest films of neurosyphilitics and an equal number of patients with arteriosclerosis of the aortic arch. In the neurosyphilitic group calcification of the ascending aorta was found in 21 patients, or 10.5 per cent. Of the patients with calcification of the aortic arch, only 1, or 0.5 per cent, presented calcification in the ascending aorta.

PAUL S. O'BRIEN, M.D.
Bowman Gray School of Medicine

Tuberculous Mycotic Aneurysm of the Femoral Artery. D. R. Sweetnam. *Brit. J. Surg.* 45: 274-276, November 1957. (The Middlesex Hospital, London, England)

The author reports a tuberculous mycotic aneurysm of the femoral artery in a 76-year-old man with active pulmonary tuberculosis. The patient had been aware of a gradually enlarging lump in the mid thigh for two months. Pulsation in the mass indicated that it arose from or surrounded the femoral artery, and a provisional diagnosis of soft-tissue sarcoma was made. This was felt to be supported by an arteriogram, which showed areas of "pathological circulation" in the region of the swelling. The arterial dilatation was thought to be due to invasion of the wall by the infiltrating growth. Bi-

opsy was done and the tuberculous nature of the mass was established. Conservative treatment was instituted but within a few weeks the aneurysm ruptured and immediate operation was required. Proximal ligation of the artery was successful and ischemia of the limb did not ensue.

The author could find no reference in the literature to the presence of such "pathological circulation" connecting with peripheral arteries unassociated with a malignant tumor.

Three roentgenograms; 1 photograph.

ROBERT S. ORMOND, M.D.
Dearborn, Mass.

Arteriography in Brachiocephalic Arteritis (Pulseless Disease or the Takayasu Syndrome). Ingmar Wickbom. *Acta radiol.* 48: 321-329, November 1957. (Roentgendiagnostic Department III, Sahlgrenska Sjukhuset, Gothenburg, Sweden)

The author presents 2 cases of brachiocephalic arteritis, pulseless disease or Takayasu disease, with special reference to the use of angiography in the diagnosis.

Obliteration of the pulse is practically always confined to the brachial artery or to the common carotid artery and their branches. The symptoms and signs are therefore often connected with ischemia in the regions which these vessels supply and may consist of intermittent claudication in the arms and the musculature of the jaw, visual disturbances, transitory hemiplegia or aphasia, tendency to fainting, etc., caused by a more or less marked constriction of the ascending branches of the aortic arch. The obliteration is usually confined to the first parts of the vessels, but it may extend as far as the axillary artery or up into the carotid arteries at the base of the skull. In advanced cases, changes may occur in the thoracic part of the aorta; they have even been described in the abdominal aorta and its branches.

The patho-anatomic changes resemble those occurring in other types of arteritis, such as temporal arteritis and endo-arteritis obliterans. The etiology is not known. The disease almost always affects young or middle-aged women and is progressive.

Biopsy was formerly the most common method for verifying the diagnosis *in vivo*, although the vascular region which is primarily involved is, as a rule, comparatively difficult of access. Oscillometry and skin temperature measurements may indirectly serve to demonstrate a vascular occlusion, but these methods do not permit any assessment of its detailed appearance, nor of its nature and site.

Arteriography has been used in a few cases to establish the location and extent of the disease process and the degree and type of the changes. Information about the existence of a collateral circulation was also obtained, as well as general data about the circulation in the vascular areas affected. The author reports 2 cases in which angiography was performed *via* the right femoral artery, the catheter tip being placed at the origin of the subclavian artery. Constriction of the lumen of the proximal portion of the subclavian artery and of the popliteal artery was evident in one patient. No collateral circulation could be detected. Considerable amelioration appeared to be obtained after treatment with cortisone; the oscillometric changes almost completely disappeared and the radial pulses were practically equal.

In the second case there was no contrast filling of the proximal portion of the right subclavian artery, but the

peripheral part was contrast filled, apparently by way of collateral channels.

The changes noted in these cases differ from those seen in arteriosclerosis in the regular nature of the constriction and the smooth walls within the occluded region. A regular constriction is not a common feature of endo-arteritis obliterans, and even if the changes occur at a site of election for this latter condition, there appears to be a reasonable chance of establishing a differential diagnosis by means of arteriography. Constrictions produced by arteriosclerosis are usually of shorter length.

Seven roentgenograms. JAMES F. MARTIN, M.D.
Bowman Gray School of Medicine

Aortography Utilizing Percutaneous Left Ventricular Puncture. John J. McCaughan, Jr., and James W. Pate. *Arch. Surg.* 75: 746-751, November 1957. (J. J. McC., VA Medical Teaching Group, Kennedy Hospital, Memphis 15, Tenn.)

The authors performed 31 percutaneous left ventricular punctures in 29 patients to obtain thoracic aortograms. Complications were limited to pneumothorax in 2 cases and infiltration of the medium into the cardiac muscle in 2. This latter complication was the result of avoidable technical errors. A total of 134 cases of ventricular puncture, including the present series, have now been reported without a fatality. The authors did not encounter injury to the coronary artery in their series.

The details of the procedure—puncture, injection, and film sequence—are described fully. The patient is placed in the right posterior oblique position to unfold the aortic arch and anesthesia is induced by thiopental (Pentothal) sodium and succinylcholine (Anectine) chloride, supplemented with nitrous oxide and oxygen. Seventy per cent sodium acetrizoate (Urokon) is the medium employed. The exposures are made with a Sanchez-Perez automatic serialograph. Employment of the Valsalva maneuver in conjunction with the injection of the medium affords superior visualization of the aortic arch and its branches.

Seven roentgenograms.

CAPT. BYRON G. BROGDON, M.C.
Parks AFB, Calif.

Complications of Translumbar Aortography Related to Site of Injection. James M. Stokes and Harvey R. Butcher, Jr. *Arch. Surg.* 75: 770-775, November 1957. (Barnes Hospital, 600 S. Kingshighway, St. Louis 10, Mo.)

The complications of translumbar aortography as related to abnormal sites of injection and their frequency in 112 patients are presented. No fatalities occurred and no renal complications were detected. Intramural injection occurred twice and is illustrated by a case history and roentgenogram. Periaortic extravasation, encountered in 6 cases, is similarly illustrated. In 4 cases visceral branches were injected without serious reaction. A well demonstrated subarachnoid injection was productive of mild, transitory neurological symptoms.

The technic employed in the Barnes Hospital (St. Louis), from which the report comes, includes the use of 50 per cent sodium acetrizoate (Urokon), with puncture well above the renal arteries. Complications as reported in several other major studies are tabulated to show an overall fatality rate of 0.8 per cent.

To help minimize complications, the authors suggest: local anesthesia; small test injection with a scout film to assure proper needle position; more dilute medium and/or slowed injection if aortic occlusion is a strong possibility; use of femoral arteriography or clinical methods in lieu of aortography when feasible.

Five roentgenograms; 2 tables.

CAPT. NEIL E. CROW, M.C.
Parks AFB, Calif.

THE DIGESTIVE SYSTEM

Alimentary Tract Obstruction in the Newborn Infant. A Review and Analysis of 132 Cases. Thomas W. Jones and Robert P. Schutt. *Pediatrics* 20: 881-905, November 1957. (T. W. J., Department of Surgery, University of Washington School of Medicine, Seattle 5, Wash.)

The authors review 132 cases of congenital obstruction of the alimentary tract seen in the Children's Orthopedic Hospital (Seattle, Wash.) from January 1935 through December 1955. Since 11 infants had multiple obstructing malformations, the total number of obstructions is 145.

There were 32 esophageal obstructions, 27 duodenal, 8 jejunal, 17 in the ileum, 7 in the colon, and 54 anal malformations. Rectocutaneous and rectourinary fistulas were included even though complete obstruction may not have been manifested.

There was no significant sex predilection, though males predominated in all groups except imperforate anus.

A high incidence of associated congenital anomalies was observed in each category of alimentary tract malformations. Ten of 32 infants with esophageal atresia had other defects, of which 8 were cardiovascular. There were 37 instances of genitourinary anomalies in infants with imperforate anus.

In the majority of cases the diagnosis can be established by the aid of a single plain roentgenogram of the abdomen. This should be obtained routinely in any newborn infant with persistent vomiting and/or abdominal distention.

Six figures; 9 tables. ROBERT S. ORMOND, M.D.
Dearborn, Mich.

Congenital Tracheoesophageal Fistula in the Neck without Atresia. Report of a Case. Michael Kraus and Harvey White. *J. Pediat.* 51: 580-583, November 1957. (Children's Memorial Hospital, Chicago, Ill.)

A rare type of tracheoesophageal fistula in the neck, in a newborn infant, is described. Approximately twelve hours after birth, the infant exhibited severe respiratory distress for which a tracheotomy was done. Attempts to pass a catheter through each nostril met with obstruction, suggesting bilateral choanal atresia. At the age of three days, jaundice was observed and feeding formula was noted about the tracheotomy tube. A catheter was placed in the upper esophagus and under fluoroscopic control about 5 c.c. of Iodochlorol was injected. The esophagus was immediately visualized, as well as a fistulous tract from the upper esophagus, at about the level of the cricoid, to the trachea. The patient's condition worsened and he died on the twenty-fifth day following gastrostomy.

Autopsy revealed a communication between the esophagus and trachea, crescentic in outline and measuring 0.5 cm. in diameter. The edges of this opening

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were smooth, as visualized from the esophageal aspect, and were continuous with the mucous membrane of the trachea. The fistulous tract between the esophagus and trachea was oblique and a probe could be passed easily from the esophagus down to the trachea and into the main bronchus. The esophagus was normal in appearance. There were marked inflammatory changes around the tracheotomy tube and a small amount of foreign material in the trachea and main bronchi.

One roentgenogram; 2 photographs; 1 photomicrograph.

Cardio-Esophageal Relaxation and Sequelae of Cardial Malposition. Michel Bugnion. *Radiol. clin.* 26: 355-358, November 1957. (In French)

To the two classical types of esophagocardial irregularities in the infant, the paraesophageal gastric hernia and the congenitally short esophagus, there is now added a group characterized by cardial malposition. This results, at least in part, from a lack of fixation of the abdominal esophagus to the peritoneal attachments which normally immobilize it beneath the diaphragm. The gradations of malposition have a common characteristic: gastro-esophageal reflux, which results in esophagitis and often peptic ulcer. The cicatricial retraction of the esophagus which follows resembles and may be confused with congenitally short esophagus.

Clinically, vomiting occurs from the first few days or months of life, being favorably influenced by keeping the child upright and thickening its feedings.

The author presents two cases, one with autopsy findings. In life the latter patient showed cardioesophageal relaxation with considerable reflux. The child had nine episodes of hematemesis, the last one of which was fatal. Autopsy disclosed a cardia with a circumference of 3.5 cm., about twice the usual size. The stomach was normal, but the inferior segment of the esophagus showed an acute esophagitis with two large ulcers perforating the wall.

Three figures. CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

An Evaluation of Radiology and Gastroscopy in the Differential Diagnosis of Gastric Ulcer. Angelo E. Dagradi and Delores E. Johnson. *Gastroenterology* 33: 703-713, November 1957. (A. E. D., 9362 Stanford Ave., Garden Grove, Calif.)

This report is based on 100 consecutive cases of gastric ulcer, in 65 of which operative verification of the nature of the lesion was available. In the other 35 patients proof of the benign nature of the ulcer was established by inference, based upon complete healing and nonrecurrence. All of these cases were studied by radiologic and gastroscopic examination prior to surgery, in an effort to evaluate these two methods with respect to their ability to establish a correct diagnosis. Of the 100 ulcers, 97 were benign, 1 was a carcinoma, and 2 were ulcerating lymphomas (Hodgkin's).

In this series x-ray examination demonstrated the gastric ulcer in 88 cases, and failed to do so in 12. Fifty-four correct diagnoses as to the nature of the lesion were made. In 15 cases diagnosis was incorrect, and in 19 cases it was indefinite. The gastroscopic method visualized the ulcer in 83 instances, and failed to do so in 17 cases. The diagnosis was correct in 73 cases, incorrect in 6, and indefinite in 4 cases.

In those cases in which the ulcer was seen by both

methods, x-ray diagnosis was accurate in 52.5 per cent, whereas gastroscopy was correct in 80 per cent of the cases.

The 12 ulcers not visualized by x-ray were located as follows: 3 on the lesser curvature of the body; 2 on the anterior wall of the body; 2 on the upper third of the lesser curvature; 4 in the region of the angulus; 1 on the anterior wall of the antrum.

Six tables.

J. S. ARAJ, M.D.
Toledo, Ohio

Operative Intestinal Arteriography. Robert Schobinger, George Blackman, and Ru Kan Lin. *Acta radiol.* 48: 330-336, November 1957. (Roswell Park Memorial Institute, Buffalo, N. Y.)

The authors describe an angiographic technic for visualizing the arterial circulation of a segment of bowel during abdominal surgery by direct puncture of the appropriate vessel. A portable Potter-Bucky diaphragm is first placed on the operating table beneath the patient. The principal artery leading to the area of interest, and its main branches, are first dissected out and a plastic catheter is inserted into the main artery through a 17-gauge spinal needle. Preferably, selected vascular areas should be filled and radiographed alternately by temporarily occluding the remaining secondary branches with small arterial clamps.

Ten to 15 c.c. of 50 per cent Hypaque is injected rapidly, and the exposure is made during the introduction of the last 2 c.c. Hemostasis is easily obtained, after withdrawal of the catheter, by means of oxidized cellulose.

With this technic the authors have demonstrated certain anatomical features of the blood supply and collateral circulation of the bowel and have visualized adenocarcinomas and benign polyps by virtue of the increased opacity they produce. No immediate or late complications have been encountered thus far, and there has been no effect on the postoperative course of the patients.

Limitations of the procedure include some tendency to blurring due to peristalsis, and the fact that separate injections are required for arterial, capillary, and venous phases.

Four roentgenograms; 1 photograph.

DAMON D. BLAKE, M.D.
Bowman Gray School of Medicine

Partial Duodenal Obstruction Secondary to Annular Pancreas. Jerome Ettinger, Eugene Spierer, and John P. Fraleigh. *California Med.* 87: 321-323, November 1957. (E. S., 373 North Hawthorne Blvd., Hawthorne, Calif.)

A single case of annular pancreas is reported in a nine-year-old girl whose repeated bouts of vomiting and dietary idiosyncrasies were thought to be emotional in origin until gastrointestinal roentgen studies were done. The stomach filled completely, but the barium was seen, fluoroscopically, to spout through the pylorus and enter a smaller viscus slightly above the lower level of the stomach and to the right of it. Roentgen films bore out the fluoroscopic observations and showed a dilated segment of duodenum distal to the pylorus.

At operation the duodenum was found to be dilated, thickened, and edematous, with a constriction formed by pancreatic tissue distal to the ampulla of Vater. Retrocolic duodenojejunostomy was done, with anastomosis of the proximal duodenum to the jejunum. Following discharge from the hospital, obstruction recurred

because of dietary indiscretion but was corrected by gastric suction and parenteral fluids. No further difficulty was encountered.

Three roentgenograms; 2 diagrams.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Correlation of the Pathologic and Radiographic Findings in Tumors and Pseudotumors of the Gallbladder. Hugh W. Jones and John H. Walker. Surg., Gynec. & Obst. 105: 599-609, November 1957. (Mason Clinic, Seattle, Wash.)

The authors studied 48 demonstrable, focal, elevated, intraluminal lesions found in 1,000 gallbladders removed at the Mason Clinic, Seattle, Wash. They classified the material pathologically and correlated their observations with the radiologic appearance. They conclude that the small, nonopaque tumors of the gallbladder, often referred to as "papillomas" or "adenomas," and generally reported as innocuous by the radiologist, may actually include some true epithelial neoplasms which may show malignant transformation. Since such tumors are radiologically unclassifiable, they constitute an indication for cholecystectomy.

The following classification was found useful. The number of cases of each type is indicated in parentheses.

1. Epithelial tumors
 - A. Papilloma (3)
 - B. Adenoma (4)
 - C. Carcinoma (12)
2. Mesenchymal tumors (1)
3. Pseudotumors
 - A. Cholesterol polyp (16)
 - B. Inflammatory polyp (4)
 - C. Cholecystitis glandularis proliferans (3)
 - D. Congenital malformations (5)

It was not possible by cholecystography to differentiate in every instance between papillomas, inflammatory polyps, and cholesterol polyps. All are single or multiple, sessile or pedunculated. The papilloma is usually a discrete single lesion and tends to be flat or sessile in contrast to multiple cholesterol polyps. The adenoma is likewise characteristically solitary and often pedunculated. Cholesterol polyps usually appear as well delineated translucencies, usually multiple and spherical because of the narrow pedicles. The diameters of these polyps, when multiple, vary from 1 to 6 mm., rarely larger. An important feature of the cholesterol polyp is the unusually intense ability of the gallbladder to concentrate. The inflammatory polyp exhibits no characteristic finding to differentiate it from the others, although it is more common in association with impaired function and cholelithiasis. The papilloma, the adenomatous polyp, and the inflammatory polyp are for practical purposes grouped together as intraluminal lesions, usually solitary, less sharply defined than cholesterol polyps, and more frequently associated with coexistent gallstones and with gallbladders showing slightly diminished ability to concentrate.

The most common anomaly is an entity commonly called "adenomyoma" but designated by the authors "myoepithelial anomaly." This has its origin in a disturbance of development of the tip of the primordial gallbladder bud. The lesion is always found in the fundus, producing a lentiform eminence covered by normal mucosa. It may show varying degrees of central umbilication.

For the demonstration of intraluminal defects in the

gallbladder, the authors take at least 2 views in the right lateral decubitus position, one before and another after the ingestion of a chologogue. Films may be taken with the patient erect, or in other modifications, as required. The authors believe that stones will invariably "layer out" while intraluminal tumors will hold their position.

Since it has been shown conclusively that some of these lesions are true epithelial neoplasms which will show malignant degeneration, the authors urge that any solitary, radiographically unclassifiable tumor of the gallbladder be regarded as an indication for cholecystectomy.

Seven roentgenograms; 11 photomicrographs; 7 photographs.
MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

HERNIA

Roentgenologic and Clinical Aspects of Hiatus Hernia. E. Hafter. Radiol. clin. 26: 382-396, November 1957. (In German)

The author uses three views for the demonstration of hiatal hernia:

Right anterior oblique (*Bauch-Rechtslage*), with the patient horizontal upon the Bucky table, with filling of the terminal esophagus. This has the advantage of freeing the esophagus and cardia from the spine. It is practically a physiologic method, but small reversible hernias are frequently missed. This view demonstrated only 61 per cent of the author's 300 cases.

For the second routine view, the patient is directly prone, with compression (a balloon about the size of either a fist or a cushion) upon the epigastrium. This is the best method for demonstrating a hernia provided compression remains within physiologic limits. These first two positions have the advantage that the hernias are not completely filled and hence the mucosal relief can be studied.

The third position is the Trendelenburg, with left side down (*Rücken-Links-Kopftieflage*). This view is not used routinely and may lead to a false diagnosis. Since the hernias are usually filled, mucosal relief cannot be studied, and differentiation from an ampulla esophagi may be difficult.

There are several indirect signs of hernia: irregularity in the mucosal relief of the terminal esophagus, an "S" form of the terminal esophagus, passage of the barium through the cardia in maximal inspiration, and reflux of barium from the stomach into the esophagus. Some radiologists consider reflux an obligatory criterion for the diagnosis of hiatus hernia. The author feels that it is not a necessary accompaniment of hernia and that may occur in the absence of the latter.

Among 2,402 examinations undertaken because of complaints referable to the upper digestive tract the incidence of hernia was 12.5 per cent, following gallstones and ulcer. Of the 300 hernias only 1 per cent were paraesophageal, the remainder being of the esophagogastric or short esophagus type.

The clinical picture is elaborated upon, and the author feels it is so characteristic it can suggest the diagnosis with great probability. The dependence of the symptoms upon position is practically pathognomonic. Associated disease, such as ulcer and gallstones, etc., was found in 53 per cent of the patients.

Of the 300 patients, 92 per cent were treated conservatively. Only 8 per cent needed surgery because

of bleeding, stenosing esophagitis, or intensive difficulties refractory to therapy.

Twelve roentgenograms; 4 tables.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

THE MUSCULOSKELETAL SYSTEM

Fibrous Dysplasia of Bone. Progress of Medical Science. Marvin L. Daves and John H. Yardley. Am. J. M. Sc. 234: 590-606, November 1957. (M. L. D., Assistant Radiologist, National Institutes of Health, Bethesda, Md.)

Fibrous dysplasia is a pyramid of diseases. The apex of the pyramid is the relatively rare Albright's syndrome and its broad, indefinite base is a multitude of monostotic lesions. The present review was undertaken in the hope of shedding some light on the confusion surrounding monostotic fibrous dysplasia. Special attention is accorded other associated problems, such as the complications encountered in classifying the numerous fibro-osseous lesions of the skull.

Albright's syndrome is characterized by multiple skeletal lesions containing fibrous tissue associated with metaplastic bone formation, areas of cutaneous pigmentation, and sexual or skeletal precocity. Polyostotic fibrous dysplasia is characterized by the same multiple bony lesions with significant extraskeletal manifestations. Café-au-lait spots may or may not be present. Craniofacial and monostotic fibrous dysplasias include those isolated bony lesions that are identical, roentgenographically and pathologically, with lesions seen in polyostotic fibrous dysplasia and Albright's syndrome. Since fibrous osteoma and ossifying fibroma are identical with lesions seen in the polyostotic disease, they are examples of monostotic fibrous dysplasia.

Because of one or more points of dissimilarity with fibrous dysplasia, nonossifying fibroma, benign cortical defects, and osteoma should be considered as distinct entities. The name "cherubism" should be used to avoid the confusion caused by calling that lesion, which is apparently distinct from fibrous dysplasia, "familial fibrous dysplasia of the jaws."

Roentgenographically, in Albright's syndrome and polyostotic fibrous dysplasia the lesions tend to obliterate the medullary canal and thin the overlying cortex. A homogeneous ground-glass medullary opacification blending imperceptibly with cortical bone, without sharp margins, is strongly indicative of the diagnosis. Roentgenographically demonstrable cysts are presumably a late feature. All of the varieties of bony lesions encountered in the parent disease have been duplicated radiologically by the monostotic form.

A bibliography of 73 references is appended.

Eleven roentgenograms; 4 photomicrographs.

Nonosteogenic Fibroma of Bone. Clinton L. Compere and Sherman S. Coleman. Surg., Gynec. & Obst. 105: 588-598, November 1957. (C. L. C., 720 N. Michigan Blvd., Chicago 11, Ill.)

Nonosteogenic fibroma of bone is a benign fibrous lesion which does not produce bone. It is found predominantly in young people and displays distinctive roentgenologic and histologic features. Twenty cases from the Registry of Bone and Joint Pathology at Northwestern University Medical School, Chicago, were studied. Eighteen of the 20 were histologically proved; 2 were diagnosed from the typical roentgenograms.

A nonosteogenic fibroma is characteristically metaphyseal in location and eccentric in site. It is seen as a sharply demarcated area of radiolucency, varying from a small oval defect in the periphery of the cortex to a larger scalloped area extending into the medullary cavity and occupying a considerable width of bone. In thin bones, such as the fibula, ulna, or radius, the whole width of the bone may be involved. Only rarely, however, does the length exceed 5.0 cm. Occasionally there is multiple involvement of the same bone. A dense, scalloped border of sclerotic bone is often seen. The larger lesions may exhibit irregular pseudolocalization. Occasionally, peripheral lesions extend outward from, but communicate with, the main lesion. Rarely, there may be no significant zone of increased density, in which case the diagnosis may not be certain.

Histologically, the most distinguishing feature is the absence of bone formation within the lesion *per se*. It consists mainly of fibrous tissue of a uniform and benign type, containing bundles and whorls of spindle cells intermingled with varying numbers of giant cells. Other microscopic features include hemorrhage, hemosiderin, cholesterol "slits", and focal collections of foam (xanthoma) cells. All "metaphyseal fibrous defects" are included in this group.

In the series studied the age range was from ten to twenty-one years. There were 7 females and 13 males, but the group is too small to make this statistically significant. The bones involved were the distal femur in 5 cases, the proximal tibia in 6, the distal tibia in 8, and the fibula in 1. In 7 of the 20 cases the initial symptom was fracture. In others, symptoms were mild or absent. An incorrect diagnosis had been made in 12 instances (60 per cent).

Treatment is individualized. Lesions which produce symptoms, which are unusually large, or through which a fracture has occurred should be removed by *en bloc* excision or curetting. Postoperative roentgen therapy is neither necessary nor advisable.

Fifteen roentgenograms; 9 photomicrographs; 1 table.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Idiopathic Hypercalcemia of Infancy, with Failure to Thrive. Report of Three Cases, with a Consideration of the Possible Etiology. Alfred M. Bongiovanni, Walter R. Eberlein, and Iris T. Jones. New England J. Med. 257: 951-958, Nov. 14, 1957. (A. M. B., University of Pennsylvania School of Medicine, Philadelphia, Penna.)

Idiopathic hypercalcemia of infancy, with failure to thrive, is a distinct clinical entity of unknown cause, although it appears highly probable that vitamin D plays an important role. This syndrome is not synonymous with true vitamin D intoxication, but it may represent an expression of hypersensitivity to the vitamin in certain infants.

The authors report 3 cases of idiopathic hypercalcemia, with failure to thrive, seen within a two-year period in the Children's Hospital of Philadelphia. The condition was severe in 1 child, mild in 2. Roentgen examination in the first case disclosed abnormal density throughout the long bones, especially marked in the zones of provisional calcification, resembling osteopetrosis, and increased density at the base of the skull. Intravenous pycnography showed poor concentration of the contrast medium, but the silhouette was adequate to rule out any abnormality; there was stippling in both

renal shadows suggestive of renal calcinosis. Roentgen studies in the second patient, at the age of twenty months, revealed a bone age of thirteen months; no abnormalities of the long bones or skull were demonstrable, and calcification in the renal area was not observed. In the third case roentgen examination showed bones of normal density and a normal bone age.

Two roentgenograms; 3 photographs; 1 graph; 1 table.

[Singleton (Radiology 68: 721, May 1957) calls attention to the roentgen features of the severe form of idiopathic hypercalcemia and reports a case.—Ed.]

Rheumatoid Spondylitis: A Clinical and Socio-Economic Study. Robert L. Swezey, James Patterson, Stanley Marcus, David Strange, and Melvin H. Levin. *Ann. Int. Med.* 47: 904-921, November 1957. (R. L. S., 10911 Weyburn Ave., Los Angeles 24, Calif.)

A detailed analysis of 100 cases of rheumatoid spondylitis from a Veterans Administration Center covers all aspects of the clinical history and findings, complications, and effects of treatment. In addition, an analysis is made of the effect on the patient's earning capacity and his adaptation to the disease. Patients with an associated peripheral joint arthritis or cardiac involvement showed the greatest disability.

In the analysis of the effects of treatment x-ray therapy was seen to be the most widely used and most effective modality. Radiation seemed to help 1 out of 3 patients in all but the very advanced stage. Other agents used in treatment were phenylbutazone and steroids.

An analysis of the x-ray findings showed that all in the group had definite evidence of sacroiliac disease bilaterally. Sixteen had a typical "bamboo" spine, while 14 showed "whiskery" bony proliferation about the pelvis. Peripheral joints were examined radiologically in 56 cases and rheumatoid arthritis was demonstrable in 31. Anemia was not found to be a complication.

The usual program of treatment consisted of conservative measures followed by one to three courses of x-ray therapy for relief of pain if needed. There was no evidence that this program was followed by leukemia. If irradiation is ineffective, butazolidin is tried, with the patient under close observation. The aim of treatment is to relieve pain and prevent deformity, since no known form of therapy will arrest the disease.

Nine tables; one graph.

GEORGE L. SACKETT, M.D.
Cleveland, Ohio

Chondroblastoma (Codman's Tumour) of the Thoracic Spine. Janusz Buraczewski, Janina Lysakowska, and Witold Rudowski. *J. Bone & Joint Surg.* 39-B: 705-710, November 1957. (Institute of Oncology, Warsaw, Poland)

A 28-year-old male with a history of increasing pain in the back for two and a half years showed spastic paresis of the lower limbs, more marked on the left, with symptoms suggesting cord compression at the level of T-3 and 4. The radiographic study showed a paraspinal mass above the left clavicle about the size of an egg, granular in structure, with an incompletely calcified shell about 1 mm. thick; there was partial destruction in the neural arches of T-3 and 4 on the left.

The possibility of tuberculosis was considered, but the findings on aspiration biopsy were typical of chondroblastoma.

This diagnosis was confirmed at operation, which showed invasion of the spinal canal by tumor tissue entering through the intervertebral foramen at the T-3 and 4 level. The intraspinal masses were removed together with the tumor from the posterior mediastinum, leaving only the calcified shell. This was followed by a 4,500 r tumor dose given postoperatively. The patient was symptomless two years after operation.

Chondroblastomas are rare tumors and none have previously been described in this location. They are most often seen at sites of rapid bone growth, such as the proximal end of the humerus or distal femur and are more common in men (80 per cent) than in women. The typical radiological appearance may be characteristic, usually an oval, translucent, well demarcated area, often with a shell-like calcified periphery, seldom associated with expansion of bone. A typical finding is the presence of small, spot-like calcifications, a mark of distinction from giant-cell tumor. Where the boundary of the tumor is effaced and the destruction passes into the metaphysis or diaphysis, the radiologic features may suggest a malignant neoplasm. Histologic examination is necessary to confirm the diagnosis.

Two roentgenograms; 2 photomicrographs.

GEORGE L. SACKETT, M.D.
Cleveland, Ohio

Fracture-Dislocation of the Lumbar Spine. Report of an Unusual Case. D. E. Robertson. *J. Bone & Joint Surg.* 39-B: 742-745, November 1957. (Peel Hospital, Galashiels, Selkirkshire, Scotland)

A direct blow to the back in the upper lumbar region resulted in an unusual posterior displacement of the 2d lumbar vertebra on the 3d, combined with a slight wedging compression fracture in the 12th thoracic and 1st lumbar vertebrae. The oblique radiographs readily demonstrated the diastasis in the intervertebral joints between L-2 and L-3. No abnormal neurologic signs persisted and full heavy work was resumed within five months.

Progress radiographic study after a year showed marked diminution of the intervertebral disk space between L-2 and L-3, but persistence of the widening in the interfacetal joints.

Seven roentgenograms.

GEORGE L. SACKETT, M.D.
Cleveland, Ohio

Disturbances in the Lumbosacral Dynamics Following Poliomyelitis. J. Jirout, J. Šimon, and O. Šimonová. *Acta radiol.* 48: 361-364, November 1957. (Neurologic Clinic, Charles University, Prague, Czechoslovakia)

A series of 60 patients ranging in age from eight to eighteen years were examined roentgenographically up to seventeen years after the acute stage of poliomyelitis. All patients were left with some residual paralysis. Lateral views of the lumbosacral spine in anteflexion, retroflexion, and with the patient erect were obtained. Fifty-two of the 60 patients were judged to have "marked disturbances of dynamics." The findings included: fixed lordosis in 39, dynamic block in 17, displacements of vertebrae in 29, and compensatory hypermobility in 16. Fixed lordosis was taken to mean a general decrease of motility of the lumbar spine. Dynamic block was defined as fixation of two neighboring vertebrae.

The dynamic disturbances in poliomyelitis are compared with those in patients with deforming spondylosis. Two roentgenograms.

JOSEPH E. WHITLEY, M.D.
Bowman Gray School of Medicine

The Direct Approach to Congenital Dislocation of the Hip. E. W. Somerville and J. C. Scott. *J. Bone & Joint Surg.* 39-B: 623-640, November 1957. (Nuffield Orthopaedic Centre, Oxford, England)

On the basis of the belief that there are certain structural abnormalities which must be corrected if the hip is to develop normally, the authors describe their routine in handling congenital dislocation of the hip. Their study is based on the results of 50 dislocations in 44 patients, with follow-up studies from three to seven and a half years. The steps of their program are as follows:

(1) *Reduction*, which they attempt to attain with the least possible trauma, utilizing a double abduction frame, permitting gradual reduction with progressive stretching of soft tissues, usually completed in four weeks.

(2) *Establishment of full medial rotation and removal of intra-acetabular obstruction*, if present. Arthrography is done under general anesthesia after the initial frame reduction. A 17 per cent solution of diiodone is injected into the hip by the anterior route. Four millimeters are usually sufficient in a child of eighteen months. With roentgen studies it is possible to ascertain the position and shape of the limbus and also to determine whether the femoral head is fully within the acetabulum. A pooling of contrast material in the inferior aspect of the joint will be present in the event of incomplete reduction. If obstruction is seen to be present and if the limbus is inverted, with incomplete reduction, operation is performed at once.

(3) *Correction of anteversion by means of rotation osteotomy of the femur.* This is done early in order to permit as rapid mobilization as possible. The osteotomy is performed immediately below the lesser trochanter and the fragments are fixed with a plate and four screws to prevent loss of position. The degree of rotational correction must be from 60 to 90° depending on the amount of anteversion and the degree of medial rotation obtained beforehand. Excessive valgus of the femoral neck should be corrected at the same time by bending the plate.

(4) The final step in the authors' routine is *mobilization*, which is begun six weeks after the osteotomy, when the plaster dressing is removed. Full movement is usually regained within six months. Sitting, crawling, and walking are encouraged as rapidly as possible. Once the child is walking, no restrictions are placed on activities.

In the 50 cases reviewed the authors have encountered few complications. Five children sustained a fracture during the period of mobilization or within a year. Forty-six hips recovered uneventfully, with results which are clinically normal. The acetabulum has appeared to develop normally even in cases where excision of the limbus had been carried out. No cases of osteochondritis of the femoral head have been noted, and the development of the capital epiphysis has been good.

Fifty-four roentgenograms; 1 photograph; 3 diagrams; 1 graph.

GEORGE L. SACKETT, M.D.
Cleveland, Ohio

Variations in Joint Space of the Hip as Shown Radiographically. G. P. Arden. *J. Bone & Joint Surg.* 39-B: 750-751, November 1957. (Heatherwood Orthopaedic Hospital, Ascot, England)

This brief article calls attention to the pitfalls in comparing joint space measurements in patients with arthritic changes in the hips. Citing a case, the author calls attention to the fact that slight variations in the angle of the x-ray beam can bring about apparent widening or narrowing of the hip joint space, a well known radiologic point which may be overlooked in the enthusiasm of evaluating progress studies.

Four roentgenograms.

GEORGE L. SACKETT, M.D.
Cleveland, Ohio

Slipped Upper Femoral Epiphysis. Characteristics of a Hundred Cases. H. Jackson Burrows. *J. Bone & Joint Surg.* 39-B: 641-658, November 1957. (25 Upper Wimpole St., London, W. 1, England)

As a part of the investigation being undertaken by the British Orthopaedic Association on the results of treatment of slipped upper femoral epiphysis, a detailed questionnaire was sent out to gather information on the clinical characteristics of the disease. This article carefully analyzes the replies to 100 of these questionnaires. In addition to the basic data on sex, age, and side of involvement, an attempt was made to bring out the possible relation of certain endocrine and physiological factors as urinary ketosteroid excretion, ascorbic acid excretion, physique, sexual development, menstrual history, and the presence or absence of endocrine defects. Information obtainable on epiphyseal maturation as judged by control films of the wrist and hand was obtained in about a third of the cases. The rôle of injury was evaluated, and clinical symptoms, deformities, and radiographic findings were analyzed.

A clear-cut etiologic classification was not possible on the basis of the statistical analysis of the 100 cases studied. As expected, boys predominated and were for the most part some three years older than the girls. Study of dietary fads and urinary ketosteroid excretion yielded no important information. No evidence was found to link skeletal retardation or thickening of the epiphyseal disks with slipping, as might be expected in a hormonal disturbance. A history of injury was present in only half of the patients and was more common in cases of sudden slipping than in those developing gradually.

In the cases of gradual slipping the cardinal symptoms were pain and a limp; the limp was continuous, whereas the pain was usually intermittent and referred more often to the hip than to the knee. Wasting was absent more often than present, but shortening was usual, as was lateral rotation.

The data compiled on height, weight, and bodily build were charted, and it would appear that the group is classifiable into those having a normal weight and height distribution and an approximately equal number who show excessive weight. From these data and from clinical evidence, it appears that one-fourth of the boys and about two-thirds of the girls showed evidence of endocrine defect apart from those who were only exceptionally fat. No relationship could be established between the constitutionally normal group or those seeming to show endocrine defect in respect to delayed epiphyseal maturation, history of injury, or sudden

versus gradual epiphyseal slipping, nor was there an establishable relation between the groups in regard to delayed maturation.

Analysis of the roentgenographic studies demonstrated, as was expected, that displacement is usually revealed most clearly in the lateral view. The apparent widening of the affected epiphyseal disk and the difficulty of identifying a vascular necrosis before collapse were confirmed radiographically.

In conclusion, the author states that his study of adolescent slipping of the upper femoral epiphysis does not demonstrate any fundamental difference in behavior between those with endocrine defects and those without.

Eight charts; 20 tables.

GEORGE L. SACKETT, M.D.
Cleveland, Ohio

Radial Nerve in Osseous Tunnel at Humeral Fracture Site Diagnosed Radiographically. H. L. Duthie. *J. Bone & Joint Surg.* 39-B: 746-747, November 1957. (Western Infirmary, Glasgow, W. I, Scotland)

In an illustrated case report the author demonstrates an osseous tunnel formed in the shaft of the humerus near the junction of the middle and distal thirds, at the site of a fracture sustained eight months previously, now solidly united. Brachial palsy was present. Operation confirmed that the healing bone had formed a tunnel about the nerve, as shown radiographically. A neuroma was excised and the intraosseous portion of the nerve was left in place. Satisfactory recovery of motor function is reported.

One roentgenogram. GEORGE L. SACKETT, M.D.
Cleveland, Ohio

GYNECOLOGY AND OBSTETRICS

Radiological Estimation of Foetal Maturity. J. Blair Hartley. *Brit. J. Radiol.* 30: 561-576, November 1957. (St. Mary's Hospitals, Manchester, England)

Precise radiological estimation of fetal maturity is indicated (1) when the date of last menstrual period is not known or is unreliable; (2) where pregnancy has already advanced beyond the expected date of delivery; (3) where, because of maternal illness, termination of pregnancy is planned and the determination of the earliest safe date for termination is essential; (4) where cesarean section is planned for a specific stage of gestation; (5) where the obstetrician finds a discrepancy between the size of the uterus or fetus and given dates; (6) where there is likelihood of multiplicity; (7) where the mother's blood is Rh negative with antibodies; (8) where there is a question of existence of pregnancy or of its duration.

There is a general feeling that the dates of appearance of fetal bony landmarks are quite variable. The author believes that this is probably due to poor technique and that, with a consistent high standard of radiography, a very real and steady pattern of bony and epiphyseal development can be demonstrated in the human fetus. For this a specific technique must be planned and carried out. This includes firm compression of the maternal abdomen, maximum speed of exposure, use of an oblique view in place of lateral view, in addition to prone and supine views. Roentgenographic studies on stillborn infants and those dying in the early neonatal period, as well as examinations of premature babies, have furnished valuable information as to the dates of appearance of reliable bony landmarks.

Comparison of the date of their delivery as predicted radiologically with the actual date has shown that 50.4 per cent of women have their babies within seven days on either side of the estimated date; 76.8 per cent within fourteen days on either side of the estimated date; 16.6 per cent between fourteen and twenty-one days outside of the estimate; 5.5 per cent over twenty-one days outside of the estimate.

Up to ten weeks ossification is so uncertain that nothing is to be gained from any attempt to identify or estimate age. From ten to twenty-four weeks, also, it is useless to try to identify bone centers or epiphyses indicative of age. From twenty-four to forty weeks foot centers and epiphyses can be reliably recognized.

Radiological postmaturity is characterized by larger or more densely ossified structures than are normally encountered, simulating the radiological findings in fetuses known to have remained *in utero* longer than the usual gestation period. This may have as great a significance as prematurity in terms of infant survival.

A detailed discussion of bony centers and epiphyses appearing between the twenty-fourth and fortieth week is included.

Twenty-five roentgenograms; 4 diagrams; 2 tables.

RICHARD P. STORRS, M.D.
Los Angeles, Calif.

THE GENITOURINARY SYSTEM

Percutaneous Transfemoral Selective Renal Arteriography in Pathologic Conditions of the Kidney. Alfredo Aguzzi, Massimiliano Campani and Sergio Chiappa. *Surg., Gynec. & Obst.* 105: 577-587, November 1957. (University of Pavia, Pavia, Italy)

For percutaneous transfemoral selective renal arteriography, as performed at the University of Pavia, Italy, a femoral artery is punctured by a cannulated needle through which a flexible metal guide and catheter are inserted. The needle is then removed and the catheter advanced in the lumen of the arterial system to the level of the artery to be studied. By suitable maneuvers under radioscopic control, it is possible to insert the tip of the previously bent catheter into the renal artery. Ten to 15 c.c. of contrast material are injected while serial films are taken. Induction of retroperitoneum one or two hours before the procedure resulted in easier identification of the renal artery and better contrast of the visualized vessels. Only one case of femoral artery thrombosis occurred in the 35 times the procedure was performed.

Normally the sinuous branches of the renal artery are uniformly distributed close to the cortex where, after some minor subdivisions, they terminate suddenly in a fairly uniform capillary bed. Under pathologic conditions there are three main radiologic patterns: (1) absence of the vascular network in a particular sector; (2) deviation or amputation of one or more vessels; (3) appearance of a pathologic vascular network. A sharp stop or crowding of the vessels, as against a compact or rigid obstacle, indicates the presence either of a cyst or hydronephrotic cavity. Small deviated vessels, or vessels of uneven or unequal caliber, or the appearance of a pathologic capillary circulation (blood lakes), suggest neoplasm.

Five illustrative cases are reported in detail.

Thirteen roentgenograms; 4 photographs.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Cryptococcus Renal Infection: Report of a Case. Alfred P. Spivack, Jay A. Nadel, and George M. Eisenberg. *Ann. Int. Med.* **47**: 990-1002, November 1957. (A. P. S., Philadelphia General Hospital, Philadelphia 4, Penna.)

A 26-year-old Negro male first came under observation for an undiagnosed pulmonary disease discovered on a survey film. There was generalized miliary nodulation throughout both lung fields with bilateral hilar adenopathy. A lymph-node biopsy was consistent with Boeck's sarcoid and there was a past history of uveitis.

Three years later symptoms of right-sided pyelonephritis developed. Pyelographic studies revealed elongation and compression of the middle and upper calyces on the right. A retroperitoneal air study failed to outline the outer or upper borders of the right kidney. At nephrectomy the kidney was found to be adherent to the surrounding tissues and a purulent nodular mass was present within and behind the kidney. Microscopic studies and cultures of the drainage from the operative site were positive for *Cryptococcus neoformans var. hominis*, and intracellular yeast-like organisms were identified as well.

A subsequent lung biopsy proved that the patient also had Boeck's sarcoid and no yeast organisms were present in the pulmonary tissue.

Three roentgenograms; 4 photomicrographs.

GEORGE L. SACKETT, M.D.
Cleveland, Ohio

Gross Bilateral Renal Cortical Necrosis During Long Periods of Oliguria-Anuria; Roentgenologic Observations in Two Cases. Hans Moëll. *Acta radiol.* **48**: 355-360, November 1957. (Roentgendiagnostic Department, University of Lund, Lund, Sweden)

Two cases of gross bilateral renal cortical necrosis are reported in women who suffered acute renal failure in connection with delivery.

Fluid retention is common in these cases, and the outlines of the kidneys are often obscured by retroperitoneal edema or ascites. When the fluid retention has been overcome, it is generally possible to register the kidney size.

In the early stage of the disease, the size of the kidneys does not differ from that usually found in acute renal failure, i.e., they are distinctly enlarged. This was true of the 2 cases reported but a rapid shrinkage ensued and the renal outlines became irregular. Cortical calcification appeared in one case after about two months and the diagnosis was then beyond doubt. In the other case the calcific deposits were too small and delicate to be seen in the films obtained *in vivo* but were demonstrable on films of the autopsy specimen.

Two roentgenograms; 2 diagrams.

PAUL W. MATHEWS, JR., M.D.
Bowman Gray School of Medicine

A Note on the Pathogenesis of Cancer in the Bilharzial Bladder. N. Makar. *Brit. J. Surg.* **45**: 240-250, November 1957. (Cairo University, Cairo, Egypt)

Attention is called to the high frequency of bladder cancer in Egypt, "the abode of bilharziasis," and the relationship between the two conditions is stressed. Bilharzial cancer supervenes after a long period of illness during which other organs, as the kidney, liver, lungs, and heart, suffer from the toxic effects of the infestation. The symptoms are on the whole similar to

those of chronic bilharzial cystitis, the difference being chiefly one of degree.

The author is concerned principally with the pathogenesis of cancer of the bilharzial type but he devotes some space to the radiologic findings. In about 60 per cent of cases of chronic bilharzial cystitis, positive shadows are demonstrated by plain films; with early malignant changes, the percentage may be as high as 84. Linear or lamellated shadows forming circumferential wavy lines around a large bladder field are characteristic of simple bilharzial changes. In cancer the shadows are denser and irregularly distributed over a smaller field. With contrast material in the bladder calcification in the vesical wall can be seen together with typical irregular filling defects representing the tumors within the bladder lumen.

Four roentgenograms; 18 photomicrographs; 3 photographs; 1 diagram; 2 tables.

ROBERT S. ORMOND, M.D.
Dearborn, Mich.

The Standardized Columbia University Cystogram. Archie L. Dean, Jr., John K. Lattimer, and Cornelia B. McCoy. *J. Urol.* **78**: 662-668, November 1957. (Squier Urological Clinic, Columbia University, New York 32, N. Y.)

The importance of a standardized technic for the pre- and post-therapy evaluation of children with dilated urinary tracts is stressed. A practical rapid procedure has been developed by the authors, and has been used in over 100 examinations without untoward reaction.

Sixty cubic centimeters of a 50 per cent solution of sodium diatrizoate are aseptically mixed with 200 c.c. of saline. The material is suspended 60 cm. above the symphysis pubis and allowed to drip through a urethral catheter previously introduced into the bladder, at the rate of 120 drops per minute. When intravesical pressure increases to such an extent that fluid no longer drips into the bladder the catheter is clamped and roentgenograms are taken.

If no reflux occurs or if reflux is unilateral, the catheter is clamped for thirty minutes and a repeat film is obtained. If still no reflux is demonstrated, a post-voiding film is taken. If reflux does occur, the bladder is drained and films are obtained to determine if contrast material is retained in the ureters or kidneys. A triple voiding technic is used in older children. The procedure can be modified in special circumstances.

Four illustrative cases are presented.

Seventeen roentgenograms; 1 photograph; 1 table.

RICHARD H. GREENSPAN, M.D.
University of Minnesota

MISCELLANEOUS

Roentgen Manifestations of Malignant Melanoma. Theodore F. Hilbish. *Am. J. Roentgenol.* **78**: 769-779, November 1957. (Clinical Center, National Institutes of Health, Bethesda 14, Md.)

The author reports upon the diverse roentgen manifestations of malignant melanoma, including reports of 9 cases, in 1 of which there was a spontaneous remission. A few comments concerning the clinical findings, prognosis, and treatment are also included.

Melanomas may occur at any age but are rare before puberty. The greatest incidence is in the sixth decade. Almost one-third occur on the head and neck, one-third on the extremities, and 20 to 25 per cent on the trunk,

with the remaining few in the eyes, on the genitalia, or in other rare sites. The vast majority arise in the skin and mucous membranes but cases primary in the meninges, adrenal glands, intestines, etc., have been reported.

The prognosis is poor, with a five-year survival of from 15 to 25 per cent, dependent largely on early recognition and proper treatment. Metastases commonly appear within six months to two years but have been reported as late as thirty-two years after surgery.

The roentgen manifestations are highly diverse and may mimic changes occurring in many other disease entities. The most common manifestation is nonspecific pulmonary metastatic disease. Extensive skeletal destructive changes may result from metastatic melanoma, such as occur also from metastasis from the breast and multiple myeloma. Other nonspecific bone changes are erosion and destruction of the cortex of the shaft of a long bone associated with periosteal reaction and calcium deposition. Melanoma may invade or displace the intestinal tract by involving the stomach and small and large intestine, with ulcers, obstruction, and other nonspecific changes. Pneumoencephalograms may demonstrate a marked shift of the ventricular system but this again is nonspecific.

Eighteen roentgenograms.

ROSCOE E. MILLER, M.D.
Indiana University Medical Center

Radiology and the Hormonal Aspects of Breast Cancer. R. A. Kemp Harper. *Brit. J. Radiol.* 30: 582-589, November 1957. (St. Bartholomew's Hospital, London, E. C. 1, England)

The results so far achieved by adrenalectomy and hypophysectomy in metastatic breast cancer have been disappointing, but almost all the patients who have undergone these procedures have had prior widespread dissemination. Occasional cases have shown remarkable improvement. This gives hope that the complicated factors which influence the growth and spread of cancer may eventually be understood and controlled.

Breast cancer spreads by blood stream, lymphatics, and direct soft-tissue permeation. Destruction of bone structure has been considered to be due to direct pressure erosion by masses of tumor cells or to a physico-chemical process where cell masses and trabeculae meet, or possibly to both. There may be extensive osseous involvement by this means before there is radiological evidence of disease. Types of metastases encountered may be purely osteolytic, purely osteoblastic, or a mixture of the two. Mixed forms are usually the result of modification by treatment.

Ten cases are reported illustrating the effects of surgical hormonal treatment including oophorectomy, adrenalectomy, hypophysectomy, and orchidectomy.

X-ray examination confirms the occasional dramatic response to hormonal treatment by surgical means. This is well illustrated by the rapid changes which may be observed in the bone metastases. These consist in varying degrees of sclerosis. When control of the disease fails, there is further reversion to the osteolytic type of lesion. Often spread of osteolytic involvement may be seen coincident with some degree of healing in the older lesions, indicating that control is incomplete and precarious.

Twenty-six roentgenograms.

RICHARD P. STORRS, M.D.
Los Angeles, Calif.

Radiological Diagnosis of Tumours of Spinal Canal. N. G. Gadekar. *Indian J. Radiol.* 11: 106-133, November 1957. (Department of Radiology, Irwin Hospital, New Delhi, India)

The x-ray examination of patients suspected of suffering from a space-occupying lesion of the spinal canal consists of two parts: a study of the bones of the spine and visualization of the canal by myelography. The skeletal changes include widening of the interpediculate distance, bone erosion, bone condensation, spine deformities, and widening of the neural foramina. These are usually of late occurrence. As a rule early localizing diagnosis is obtainable only with myelography. This procedure is discussed in detail. The various contrast media which may be used, their advantages and disadvantages, are enumerated.

The author reports his own myelographic studies on 96 patients, in 33 of whom tumors were found. Brief histories and illustrations of a wide variety of lesions of the spinal cord are included.

Sixty-eight roentgenograms. Four diagrams.

J. S. ARAJ, M.D.
Toledo, Ohio

Visceral Roentgen Findings in Osteomyelosclerosis. C. Wieser and U. M. Isler. *Radiol. clin.* 26: 329-333, November 1957. (In German) (Zentral Röntgeninstitut des Kantonsspitals St. Gallen, Switzerland)

Osteomyelosclerosis is characterized by the triad of splenomegaly, leukoerythroblastosis, and marrow fibrosis. In some of the far advanced cases there is a roentgenologically detectable osteosclerosis.

The large spleen reflects the myeloid metaplasia. It has been suggested that the process is not a simple vicarious extraosseous erythropoiesis, but a neoplastic process of the reticulohistiocytic system which may involve not only the spleen but other organs.

The authors present 2 cases, 1 with autopsy. The first showed some blood-forming foci around the pelvis of the left kidney with a urate stone in the ureter and hydronephrosis. The urate stone is characteristic, and, as in leukemia, results from the breakdown of the nucleoprotein-rich blood cells.

The second patient presented a tumor-like mass in the pericecal region demonstrable on barium enema study. Four months later, after numerous blood transfusions, the defect was no longer visible.

Six roentgenograms; 2 photographs.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Death from Intra-Abdominal Hemorrhage Simulating Reaction to Contrast Medium. Robert W. Counts, Gordon B. Magill, and Robert S. Sherman. *J.A.M.A.* 165: 1134, Nov. 2, 1957. (R. S. S., 444 East 68th St., New York 21, N. Y.)

In recent years, death of a patient while undergoing intravenous urography has been attributed in a number of instances to the contrast medium. The authors report a case to illustrate the difficulty which may arise in differentiating clinically between an acute reaction to the contrast material and other conditions which may simulate it.

The patient, a 28-year-old male, was admitted to Memorial Hospital (New York, N. Y.) with generalized metastases. He was anemic but there was no suspected or known source of bleeding. Approximately one month previously, at another hospital, exploratory

laparotomy had disclosed a nonresectable retroperitoneal tumor, which on biopsy proved to be a choriocarcinoma. The patient was referred for excretory urography. A preliminary conjunctival test for iodine sensitivity was negative. Approximately five minutes after the intravenous injection of 30 c.c. of sodium diatrizoate, the patient experienced epigastric pain, perspired profusely, and became dyspneic and cyanotic. It was believed that the sudden onset of this acute state probably represented a severe reaction to the contrast medium, and appropriate treatment was instituted, with little or no clinical improvement. Death occurred in shock in about four hours. At autopsy, 3,500 c.c. of bloody fluid was discovered in the peritoneal cavity. There were multiple hemorrhagic nodules in the liver, the largest 7 cm. in diameter. A rent was found in this nodule from which blood gushed when the liver was compressed. It was established that death was due to spontaneous rupture of this metastasis with massive hemorrhage.

Forensic Skiagraphy. L. Henry Garland. California Med. 87: 295-297, November 1957. (450 Sutter St., San Francisco 8, Calif.)

Since juries are composed of laymen, they cannot be

expected to interpret roentgenograms. The author believes, therefore, that only reports should be presented to the jury or that the films be demonstrated by a court-appointed expert to avoid deliberate creation of misleading impressions to arouse unjustified sympathy. [This would also obviate instances of conflicting testimony by radiologists representing the two sides.]

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Changes in Requirements for Certification in Radiology. Donald S. Childs. J.A.M.A. 165: 1545-1547, Nov. 23, 1957. (713 E. Genesee St., Syracuse 2, N. Y.)

Dr. Donald S. Childs, Chairman of the Section on Radiology at the 106th Annual Meeting of the American Medical Association, discusses the changes which have been made in the past few years in the requirements for examination by the American Board of Radiology, the type of certificate issued, and the material covered by the examination. Rapid advancements in the field of radiology have been such that, after 1960, examinations in radiology given by the Board will automatically include nuclear medicine. Most of this material appears in the September 1957 issue of RADIOLOGY (69: 428, 1957).

RADIOTHERAPY

Cerebrospinal Irradiation for Medulloblastoma. Arthur Jones and G. S. Innes. Brit. J. Radiol. 30: 590-592, November 1957. (St. Bartholomew's Hospital, London, E. C. 1, England)

Medulloblastoma arises most frequently in the posterior cranial fossa and is predominantly a disease of childhood. Because this radiosensitive tumor has a tendency to spread throughout the subarachnoid space, radiotherapy must be directed to the whole cerebrospinal axis. This involves a large proportion of the body, especially in children, including much hematopoietic tissue. To achieve uniform irradiation of the potential tumor-bearing area and still spare normal tissues, is particularly difficult. Since the most likely site of recurrence is the posterior fossa itself, this must receive efficient and homogeneous irradiation.

The authors use a special apparatus made of Perspex and lead, constructed individually for each patient to provide the required protection. Cranial irradiation is through lateral fields and spinal irradiation through posterior fields.

The case of a boy of ten years in whom this technic was employed is reported. A cranial tumor dose of 3,000 r and a dose of 2,000 r to the spinal cord were delivered in fifty-eight days, beginning three weeks after surgical excision of the tumor. The irradiation factors were 250 kv, 15 ma, h.v.l. 1.85 mm. Cu, F.S.D. 60 cm., with diaphragm. Eighteen months later the patient appeared well and was attending school regularly.

A different technic for adult patients, using a million-volt beam, is briefly outlined.

Six photographs. RICHARD P. STORRS, M.D.
Los Angeles, Calif.

Results of Treatment of Carcinoma of Lower Lip. Simon Krantz, Israel R. Berger, and Pierpont F. Brown. Am. J. Roentgenol. 78: 780-789, November 1957. (S. K. VA Hospital, 5998 Peachtree Road, N. E., Atlanta, Ga.)

This article was written to compare the results of ir-

radiation and surgery in 189 patients with carcinoma of the lower lip treated between 1935 and 1950. Of this group 58 received radium therapy, 51 superficial roentgen therapy, and 18 high-voltage x-ray therapy; 62 were treated by surgical means. The type of treatment depended primarily upon when the patients were seen during this period. One hundred and sixty of the patients had histologic evidence of squamous-cell carcinoma and one of adenocarcinoma. The rest were judged clinically to have carcinoma.

For radium therapy a mold designed to cover the lip was used, with the tubes so placed as to cross-fire from external, superior, and internal aspects. Total dosage varied from 500 to 2,000 mg. hr. over a period of two to four days.

For superficial roentgen therapy the usual factors were: 140 kv, 0.25 mm. Cu plus 1.0 mm. Al filtration, 16.5 cm. distance. The total dose (in air) varied from 2,000 to 4,000 r depending on the size of the lesion (smaller lesions received more daily dosage but less total dosage).

Deep roentgen therapy factors were: 200 kv, 0.5 mm. Cu plus 1.0 mm. Al filtration, 50 cm. T.S.D. Total dosage varied from 3,650 to 5,000 r with a daily dose range of 500 to 750 r. In both deep and superficial roentgen therapy lead protective devices were used for the mandible and teeth.

When surgical treatment was instituted, a complete excision of the lesion was performed. At times plastic procedures were necessary for closure. Routine prophylactic neck dissection was not done, but in the presence of metastatic lymph nodes such a dissection was the procedure of choice. This operation was not felt to be routinely indicated because of the slowness of development and extension of carcinoma of the lower lip as compared to intraoral carcinoma.

The relative cure rates were 86 per cent, 88 per cent, and 85 per cent with radium, superficial roentgen therapy, and deep roentgen therapy, respectively. The absolute cure rates were rather low, 74, 74, and 61 per

cent, but these figures are not felt to be a true indication of the curability of the lesion. Cure rates are considerably increased if patients salvaged by further treatment are included.

When the failures of radium therapy are analyzed in relation to dosage, it is difficult to attribute them to inadequacies of dosage or technic. With superficial roentgen therapy, it seems as though 3,500 to 4,000 r will yield excellent cosmetic results, with almost no recurrences. Deep roentgen therapy is probably equally as good as superficial.

The results of surgical treatment are divided into two groups. The cure rates for the first group, in which the lesion was confined to the lip, were 85 per cent relative and 79 per cent absolute. The corresponding figures for the group with lymph node involvement were 50 and 47 per cent.

The following conclusions are drawn:

1. Uniform results are obtained with the accepted methods of treatment of primary lower lip carcinoma.
2. The incidence of recurrence and metastasis after careful initial treatment is low.
3. Prophylactic neck dissection is not indicated.
4. Results in cases of inoperable metastatic disease are disappointing.

Fifteen photographs; 3 tables.

GERALD KURLANDER, M.D.
Indiana University Medical Center

Adenoid Cystic Carcinoma of the Oral Cavity, Paranasal Sinuses, and Upper Respiratory Tract. Merall Roth. *Am. J. Roentgenol.* 78: 790-803, November 1957. (14 Via Cheparro Dr., San Rafael, Calif.)

Twenty-two cases of adenoid cystic carcinoma, or cylindroma, of the oral cavity, paranasal sinuses, and upper respiratory tract from the literature are reviewed, and 4 personal cases are added. These tumors closely resemble the cystic type of basal-cell carcinoma. Most of them are found in the major salivary glands but they may arise in the minor salivary or mucous glands found in the oral and nasal cavities, paranasal sinuses, upper respiratory tract, and bronchi. Some arise in the lacrimal gland, and others in the skin and breast. Growth of the tumor is slow; infiltration is insidious, and metastasis occurs late.

The location of the tumor frequently makes it difficult to remove it surgically with adequate margins. In none of the cases with an adequate follow-up (ten years) has a cure been obtained by any method of therapy. In spite of this unfavorable outlook, the author urges aggressive action when the tumor is first discovered. Resection well beyond the perceptible limits of the lesion should be followed by irradiation, preferably with radium, cobalt, or megavoltage roentgen rays. The dose necessary for cure is not known. The details of radiation in 10 cases are tabulated. In general, "it would seem wise to spread the treatment over a long time, six to ten weeks, so as to bring the total tumor dose above the 6,000 r which appears to have been insufficient.

Eight roentgenograms; 4 photomicrographs; 7 photographs; 4 tables.

THOMAS R. MARSHALL, M.D.
Indiana University Medical Center

Results of Treatment of Carcinoma of the Breast—Five to 18 Years. James W. Hendrick. *Ann. Surg.* 146: 728-750, November 1957. (Tuscaloosa, Ala.)

The author observed 562 patients with carcinoma of

the breast between 1933 and 1951, of whom 473 had radical mastectomy. Of 177 who had involvement of the breast alone, 70 per cent were living and clinically free of disease five to eighteen years later. Of 226 patients with axillary involvement, 38 per cent were alive and apparently free of disease.

For radiotherapy the author favors low-intensity radium needle implants in the supraclavicular and internal mammary areas rather than external radiation, although he has used both. No experimental studies, clinical data, or reasons for using interstitial irradiation rather than roentgen therapy are mentioned.

Strict criteria of operability are presented, and surgical technics are described in some detail. The simple mastectomy followed by radiation therapy, as advocated by McWhirter, is criticized quite strongly and Ackerman's evaluation of McWhirter's work is cited (*Cancer* 8: 883, 1955. *Abst. in Radiology* 67: 149, 1956). Review of McWhirter's data shows a five-year crude survival rate of 58 per cent in 1,063 operated cases. The author's five- to eighteen-year crude survival rate on 403 cases treated by radical mastectomy with and without postoperative x-ray therapy is 60 per cent. The difference between the two series would not appear to be of great significance.

Seven figures; 5 tables.

RICHARD H. GREENSPAN, M.D.
University of Minnesota

Results of Radiation Therapy of Bronchogenic Carcinoma at the Medical University Clinics, Erlangen (1945-1955). Gunther Barth, Walter Brichzy, Wolfgang Frik and Viktor Pitas. *Strahlentherapie* 104: 355-365, November 1957. (In German) (Medizinische Universitätsklinik, Erlangen, Germany)

Bronchogenic carcinoma is known to be radioresistant and the impression prevails that roentgen therapy has very little effect on the course of the disease. In recent years, however, it has been shown that even in far advanced cases the survival period can be prolonged when a large tumor dose is applied.

The authors discuss the results of high-voltage roentgen therapy in 415 cases, observed from 1946 until 1955. The diagnosis was made roentgenologically in all cases, and was verified by cytology in 58 per cent and histologically in 22 per cent. Fifty-two patients (12.5 per cent) were operated upon; of the remaining 363, 73 per cent could be treated by roentgen methods.

In the first three years high-voltage therapy was applied with stationary fields. Beginning in 1949 rotational therapy was added. An average single dose was 200 r, a total weekly dose 1,000 r. In 22.3 per cent of those treated the total dose applied was 2,000 r or less, in 40 per cent it was up to 5,000 r, and in 37.2 per cent over 5,000 r.

The results appear encouraging in view of the following observations: The average survival was 7.6 months or 2.8 months longer than in the nonirradiated group. The average duration of the disease after onset of symptoms was 16.72 months as compared to 12 months previously. More than one-half of the patients (60.8 per cent) died within six months after the beginning of roentgen therapy, 20.4 per cent within six to twelve months, and 11 per cent between twelve and twenty-four months. The higher the tumor dose, the longer was the survival. The most favorable results have been achieved with the following combination: rotational therapy with small fields for the primary tumor and

stationary beam with large fields through a grid for the mediastinal lymphatic system.

Since indications and contraindications for irradiation represent variable factors, the statistical results of radiotherapy will be more favorable when relatively few cases are selected.

One graph; 4 tables. ERNEST KRAFT, M.D.
Northport, N. Y.

Evaluation of the Combined Effects of Hematoporphyrin and Radiation. I. Treatment of Carcinoma of the Cervix. H. Patterson Mack, William K. Diehl, George C. Peck, and Frank H. J. Figge. *Cancer* 10: 529-539, May-June 1957. (University of Maryland School of Medicine, Baltimore, Md.)

Twenty-four patients with squamous-cell carcinoma and 1 with adenocarcinoma of the cervix were treated with combined hematoporphyrin and irradiation. Four of the tumors were Stage I, 2 Stage II, 10 Stage III, and 6 Stage IV. Three patients had tumors which failed to respond to an initial course of irradiation and were given hematoporphyrin during a second course of radium treatment. Eighteen patients received hematoporphyrin during combined radium and roentgen therapy. Two patients with Stage I carcinoma were given hematoporphyrin during radium therapy; this treatment was followed by a Wertheim operation. Two patients received hematoporphyrin during roentgen therapy.

The radium treatment plan called for the application of 75 mg. of radium endocervically and a plaque containing 75 mg. of radium contracervically; the radium was left in place for thirty hours, for a dose totaling 4,500 mg. hr. The factors for the roentgen therapy were 220 kvp, 20 ma, 0.5 mm. Cu and 1 mm. Al filtration, half-value layer 1.25 mm. Cu; doses were divided by cross-firing through four 15 X 15-cm. ports, right and left, anterior and posterior, at a target-skin distance of 50 cm.

The hematoporphyrin-treated group of patients had an initial-response time of twenty-five and a half days, while that for the nonporphyrin-treated patients was thirty-nine and a half days. This difference is considered to be significant. Thirteen of the patients receiving hematoporphyrin appeared to have had a better early clinical course than would have been expected with radiotherapy alone.

Patients given hematoporphyrin seemed to withstand irradiation unusually well. Photosensitivity and occasional hypotension, however, presented new problems of clinical management.

In this series, there was no significant alteration of life expectancy in the hematoporphyrin-treated patients.

The authors stress that combined hematoporphyrin and radiation therapy should be considered as purely experimental at the present time. Their results and those of others indicate the need for further investigation in this field.

Five graphs; 6 tables.

Effects of Radiation Quality, Target-Axis Distance, and Field Size on Dose Distribution in Rotation Therapy. Edith H. Quimby and Beverly S. Cohen. *Am. J. Roentgenol.* 78: 819-830, November 1957. (E. H. Q., 630 W. 168th St., New York 32, N. Y.)

In rotational therapy one is constantly confronted with the ratio between the maximum skin dose and the

axis dose. Usually, if one can keep this ratio small, the plan of therapy is more satisfactory. Both intrinsic and extrinsic factors enter into the problem. This paper deals with the extrinsic factors, namely, radiation quality, target-axis distance, and field size.

In order to study the effect of variation of the above factors, three different regions of the body—head, pelvis, and thorax—were studied. The dosage determinations were, in general, calculated according to a method previously published by the authors (Castro, Soifer, and Quimby: *Am. J. Roentgenol.* 73: 815, 1955. *Abst. in Radiology* 66: 479, 1956). Some doses, however, were checked by ionization measurements in a rotating Presdwood phantom. Radiation qualities ranged from a half-value layer of 1.0 mm. of copper to 15.0 mm. of copper, the latter corresponding to the radiation from cobalt 60. The target-axis distance was about 85 cm. Some few distances of 115 cm. were used.

The following conclusions were reached: Lesions in the interior of the head can be adequately treated with roentgen rays of relatively low half-value layer and short target-axis distance. An increase in the half-value layer or distance will improve the ratio of skin to axis dose, but this is seldom necessary.

In treating lesions in the average pelvis, at least 2.0 mm. of copper half-value layer and a target-axis distance of 85 cm. are needed. Better ratios can be had if the half-value layer is increased to 4.0 mm. of copper or the distance to 115 cm. However, supervoltage is of great advantage in these cases.

For chest lesions, adequate treatment of many esophagus and lung lesions can be obtained with a half-value layer of 2.0 mm. of copper and 85 cm. target-axis distance. This is due to diminished absorption of radiation by lung tissue, which leads to higher depth doses. Again supervoltage has a marked advantage.

The field size was found to have a lesser influence than the quality of radiation and the target-axis distance.

Three photographs; 14 graphs; 8 drawings; 2 tables.

EARL R. BROWN, JR., M.D.
Indiana University Medical Center

Clinical Studies Concerning the Influence of Pregnancy on the Course of Neoplastic Diseases. Josef Becker and Ivo Meier. *Strahlentherapie* 104: 384-397, November 1957. (In German) (Czerny-Krankenhaus für Strahlenbehandlung, Universität Heidelberg, Germany)

Pregnancy has an unfavorable and frequently deleterious effect on a pre-existing malignant neoplasm. Consequently, one has to consider the advisability of interruption and of prophylactic castration. Statistical evaluation of therapeutic results, however, is lacking, and each case still requires individual planning.

The authors' material consists of 51 cases, or 1.43 per cent of 3,557 women hospitalized for malignant tumors from 1906 until 1939. The series included 21 breast cancers, of which 4 were bilateral mastitis carcinomatosa, 8 showed pulmonary seeding, 1 had spread to the bones, and 1 to the liver. In this group there was only 1 three-year survival, which testifies to the ominous nature of the complication. Pregnancy is always contraindicated in breast cancer, even after prolonged clinical cure, and therapeutic castration is warranted for prophylactic reasons and for prevention of recurrences.

Among 13 cases of cancer of the cervix in a far ad-

vanced stage there were 2 three-year survivals. Pregnancy has very little influence on the course of the malignant process in the cervix, but rapid progression occurs following childbirth and during the puerperium. Therefore, total hysterectomy with postoperative irradiation is indicated in the early period of gestation. In advanced pregnancy, electron-beam therapy has now become possible, since it has no effect on the fetus.

In malignant melanoma rapid growth and spread of the tumor are frequently provoked by pregnancy. Active treatment and prophylactic castration are indicated. Lymphogranulomatosis is also known to be aggravated by pregnancy and calls for active treatment without delay.

One table.

ERNEST KRAFT, M.D.
Northport, N.Y.

RADIOISOTOPES

A Few Notions Involved in the Clinical Use of Radioisotopes. Gould A. Andrews. *Ann. Int. Med.* 47: 922-937, November 1957. (Medical Division, Oak Ridge Institute of Nuclear Studies, Oak Ridge, Tenn.)

This paper, delivered before the American College of Physicians, was designed to define and illustrate some basic concepts that may be helpful to physicians using radioisotopes in diagnosis and therapy. The author states that nothing new is presented and that much of the material would seem unnecessarily trite to those experienced in this field.

Eleven illustrations.

The Endocrine Dependency of Certain Thyroid Cancers and the Danger That Hypothyroidism May Stimulate Their Growth. George Crile, Jr. *Cancer* 10: 1119-1137, November-December 1957. (Cleveland Clinic Foundation, Cleveland 6, Ohio)

The purpose of this article is to point out that many metastasizing cancers of the thyroid are dependent neoplasms, and that their growth, like that of cancers of the prostate and the tumors induced by Furth (*Cancer Res.* 13: 477, 1953), is subject to control by alterations in the balance of the endocrine system.

There is increasing evidence that many tumors of the thyroid, benign and malignant, are to varying degrees dependent for their growth on thyroid-stimulating hormone (TSH) from the pituitary, and reports of successful treatment of nodular goiter by thyroid feeding, the effects of which have been attributed to suppression of TSH, are numerous.

During the last eight years 39 patients with inoperable or metastatic cancer of the thyroid have been treated at the Cleveland Clinic with desiccated thyroid in doses of 3 to 6 gr. daily and followed from one to seven years or until their death. The response to treatment was related closely to the type of tumor. None of 10 *undifferentiated* carcinomas showed any response to thyroid feeding. The results in 7 *adenocarcinomas* are not regarded as significant. The growth of 2 of 3 *medullary* carcinomas appears to have been arrested for from two and a half to four and a half years, but in both cases the issue is complicated by the fact that irradiation was given. Of 2 patients with metastases from low-grade encapsulated *angioinvasive* carcinomas, 1 showed no response, and the thyroid also failed to concentrate I^{131} . Growth of pulmonary metastases in the other patient appears to have been arrested for a period of two years. The most impressive response to thyroid feeding occurred in patients with *papillary* carcinomas or their follicular variants. The 17 cases in this group are reported briefly. Since most of these cancers are cured permanently by surgical removal, it is only the most widely metastasizing and poorly differentiated of the papillary tumors that escape from

surgical control and require other forms of treatment. If the more localized and differentiated papillary tumors were treated by thyroid, the results might be even more spectacular than in the cases of surgically uncontrollable papillary carcinoma reported here.

Since June 1953, all patients operated upon at the Cleveland Clinic for cancer of the thyroid have been given 2 to 3 gr. of desiccated thyroid daily, starting as soon as the diagnosis was established. It is too early to evaluate the results, but during the first two and a half years 50 patients were operated upon. In all but 2, the entire primary tumor and its grossly evident cervical metastases were removed. At the time of the present report, one to three and a half years after operation, only 2 patients who took thyroid as prescribed have shown any persistence or recurrence of their tumors. In 2 others operable recurrences have developed in the lymph nodes lying outside of the field of the primary operation.

No striking stimulation of cancer of the thyroid has been observed after treatment with I^{131} , but care has been taken not to maintain hypothyroidism for more than a few weeks, because of an early experience. In 1950, a patient was treated with I^{131} for a cancer of the thyroid associated with severe hyperthyroidism; "snowball" metastases in the lungs had been static on serial roentgenograms for several years. As soon as the I^{131} controlled the hyperthyroidism that was attributable to an adenoma in a different part of the thyroid, the cancer was stimulated to growth and the patient died within a few months. In 5 other cases, there was a significant stimulation of metastases following administration of I^{131} .

After a discussion of the factors that stimulate the growth of differentiated, dependent cancers or change them to undifferentiated autonomous types, the author concludes:

Thyroidectomy or treatment with I^{131} or thiouracil may stimulate the growth of well differentiated thyroid cancers or may even convert them to anaplastic carcinomas.

It is probably not the radiation from the I^{131} but the secondary hypothyroidism and the increased output of thyroid-stimulating hormone that stimulates the cancer.

Desiccated thyroid in doses of 3 gr. or more daily inhibits the production of thyrotropic hormone and often causes regression of differentiated thyroid cancers.

Most inoperable thyroid cancers should not be treated by I^{131} until they have been given a trial on treatment with desiccated thyroid.

All patients operated on for thyroid cancer should be given desiccated thyroid to prevent recurrences.

Eleven roentgenograms; 2 photographs; 3 photomicrographs.

Fibrosarcoma Involving the Thyroid Gland of a Sheep Given I^{131} Daily. Sidney Marks, Lynn A. George, Jr., and Leo K. Bustad. *Cancer* 10: 587-591, May-June 1957. (Biology Operation, Hanford Laboratories, General Electric Co., Richland, Wash.)

An investigation involving the chronic exposure of thyroid glands of sheep to ionizing radiation by means of the daily feeding of small quantities of I^{131} has been in progress for five years (see also *Radiation Res.* 6: 380, 1957. *Abst. in Radiology* 70: 151, 1958; *Am. J. Path.* 33: 219, 1957. *Abst. in Radiology* 70: 307, 1958). The only definitely malignant tumor encountered as yet in the thyroid region in this experiment was initially observed at the age of fifty-three months in an ewe exposed to a low level of I^{131} (5 microcuries daily) continuously since fetal life. The cumulative radiation dose to the thyroid gland was estimated to be 30,000 rads. The tumor proved to be a fibrosarcoma. It was impossible to tell whether it arose in the fibrous septa within the gland or in the surrounding connective tissue.

The tumor was anatomically centered around the site of the right lobe of the thyroid in such a manner that there is little doubt that it arose within the field of the beta radiation emitted by the I^{131} concentrated in the gland. The location of the tumor with respect to the field of radiation and the absence of evidence suggestive of the frequent spontaneous occurrence of fibrosarcomas at this site in sheep permits the inference that a causal relationship existed between the I^{131} in the thyroid and the tumor.

Two photographs; 5 photomicrographs; 1 graph.

Dosage Distribution in Rotational Cobalt 60 Therapy. A Simplified Method of Computation. C. Gregory. *Brit. J. Radiol.* 30: 538-543, October 1957. (Physics Department, Mount Vernon Hospital and The Radium Institute, Northwood, Middlesex, England)

Using isodose charts for a source-skin-distance of 60 cm. and placing the center of rotation at 15 cm. depth, the author constructed a chart giving the dose at 1 cm intervals along one of the radii for 18 fixed fields 20° apart. From this chart, isodose distributions can be obtained, based on 100 per cent at the center of rotation for full or partial rotation, which will vary little from those obtained by taking into account the irregular contour of the patient. This is true even for eccentrically placed tumors. The dose at the center of rotation is calculated on the mean radius of the patient's outline. The maximum error due to this approximation is 4 per cent.

Five figures; 4 tables.

LUCILLE DU SAULT
Henry Ford Hospital

Urological Complications Following Use of Radioactive Gold for Carcinoma of Uterine Cervix. M. Richard Carlin. *J. Urol.* 78: 650-661, November 1957. (607 N. Grand Blvd., St. Louis, Mo.)

Twenty-two urinary tract complications were observed by the author in a series of 135 patients with carcinoma of the cervix or endometrium treated with parametrial injections of radioactive gold. With one exception, all patients receiving gold were also treated by one of the more conventional methods: radium applications, roentgen therapy, or surgery.

Of the 22 complications, 10 were attributed directly to the gold. The other 12 were associated with other conditions, usually persistence or recurrence of tumor. There were 3 cases of irradiation cystitis, 4 of irradiation

parametritis with hydronephrosis, and 3 cases of a combination of both of the above entities. Four cases are reported, 1 of which terminated fatally.

It is difficult to be certain that the observed complications are actually due to the gold and not to radium applications. The author stresses that whereas radiation ulcer from radium is always located on the posterior third of the bladder base, and almost always in the midline, the ulcers observed from gold were on the lateral bladder wall. The importance of meticulous technic in inserting the gold is stressed.

Eleven roentgenograms; 1 table.

RICHARD H. GREENSPAN, M.D.
University of Minnesota

Experience with Radioactive Phosphorus in Tumor Detection. Edwin B. Dunphy, Joseph L. Dowling, Jr., and Alfred Scott. *Arch. Ophthalm.* 57: 485-490, April 1957. (E. B. D., 243 Charles St., Boston 14, Mass.)

It has been definitely shown both by radioassay and radioautographs that malignant tumors concentrate P^{32} to a greater degree than other ocular tissues after intravenous injection (see, for example, Thomas, Krohmer, and Storaasli: *Arch. Ophthalm.* 47: 276, 1952. *Abst. in Radiology* 60: 154, 1953). The authors report their experience at the Massachusetts Eye and Ear Infirmary (Boston) with that isotope in a series of 50 intraocular lesions of either proved or suspected malignancy (31 tumors of the choroid and ciliary body, 16 of the iris, 3 retinoblastomas). An average-size adult is given 750 μ c of P^{32} intravenously as buffered sodium phosphate. Small frail adults are given only 500 μ c, and children under twelve much less. Approximately twenty-four hours after the injection of P^{32} , the counting is begun, with the patient in the prone position. Both eyes are anesthetized with tetracaine (Pontocaine) hydrochloride, 0.5 per cent. A specially designed Geiger counter is placed squarely in contact with the eyeball for one minute and the counts are recorded. A similar count is made on the normal fellow eye, or, in a one-eyed person, in a remote quadrant of the same eye. At least three counts are made in each location.

The authors conclude that, under present conditions, the P^{32} test seems to provide a high degree of reliability as an adjunct to the clinical diagnosis of choroidal melanomas when they are accessible to the counter by reason of anterior location. Although the maximum range of β -ray emission of P^{32} is 7 to 8 mm., the average is only 2 to 3 mm. It is therefore apparent that negative tests are of no significance in posterior lesions unless the counter can be accurately placed. The test would appear to be of considerable accuracy in iris lesions by reason of their accessibility and accurate visualization.

It is emphasized that any evaluation of the P^{32} test in detecting intraocular tumors is in reality an evaluation of the methodology employed. This isotope will prove of increasing value as the present technical difficulties are overcome.

The Effects of Irradiation with Phosphorus-32 on the Viability and Growth of Rat Embryos. Melvin R. Sikov and Thomas R. Noonan. *Radiation Res.* 7: 541-550, November 1957. (M. R. S., Department of Radiology, Wayne State University College of Medicine, Detroit, Mich.)

The effects of β -radiation on rat embryos six, eight, nine, and ten days of gestational age was studied by the

intraperitoneal administration of radioactive phosphorus (P^{32}) to pregnant females. Values for the LD 50 were found in terms of the doses of P^{32} which, when administered to the mother, would be expected to kill 50 per cent of the fetuses by the fourteenth day of gestation. These values, which were found to be dependent on the day of gestation on which injection was made, were: Day 6, 0.46 mc, Day 8, 0.57 mc; Day 9, 0.77 mc; and Day 10, 1.29 mc.

The uptake of radiophosphorus was also studied at several doses. From these data, the radiation doses to the embryo were calculated for each day of gestation. By interpolation of the uptake data it was possible to estimate the radiation dose received by an embryo at the LD 50 level. For the first four days after injection these were: Day 6, 300 rep; Day 8, 450 rep; Day 9, 560 rep; and Day 10, 925 rep. It was also found that uptake was proportional to the injected dose, indicating no major interference with phosphorus metabolism.

All doses of P^{32} produced a depression of the weight of the embryos as measured on the fourteenth day of gestation. The magnitude of the depression followed the same pattern as did the LD 50, earlier embryos being more sensitive.

Two figures; 4 tables.

Measurement of Gastro-Intestinal Bleeding Using Radioactive Chromium. R. M. Bannerman. Brit. M. J. 2: 1032-1034, Nov. 2, 1957. (St. Thomas's Hospital, London, England)

The author describes a method utilizing radiochromium in tracer doses for the estimation of fecal blood loss. The patient's own red cells are tagged with the isotope. Venous blood (20 ml.) is withdrawn into a sterile bottle containing 1,000 international units of heparin. The bottle is centrifuged and the supernatant plasma removed. The red cells are then mixed with an isotonic solution containing Cr^{51} as sodium chromate in saline. After standing for half an hour, the red cells are washed, resuspended in saline, and injected intravenously. Sample counting of venous blood and stools is done on 5-ml. aliquots.

All stools passed are collected in successive twenty-four-hour periods, and the amount of blood, in milliliters, present in each twenty-four-hour collection is obtained from the expression

Total activity of stool collection in counts per second
Activity of blood in counts per second per milliliter

Results obtained in 3 patients are given to illustrate the value of the method. It not only furnishes information as to the quantity of blood lost daily but may indicate the possible source of bleeding. Correlation with the qualitative benzidine occult blood test was in general good. The chromium method has least value when blood loss in the stools is as little as 3 ml. or less.

One graph; 1 table. ROBERT S. ORMOND, M.D.
Dearborn, Mich.

The Use of Radiochromium in a Case of Clinically Unrecognized Recurrent Regional Enteritis with Occult Hemorrhage. E. Richard Ensrud, Charles A. Owen, Jr., William H. Dearing, and John M. Waugh. Gastroenterology 33: 837-841, November 1957. (Mayo Clinic and Mayo Foundation, Rochester, Minn.)

Since radiochromium (Cr^{51}) preferentially labels erythrocytes when mixed with blood, and since there is no evidence that it can enter the bowel except by

bleeding, a convenient and quantitative measure of intestinal bleeding is available.

The authors report two studies on a 35-year-old patient, who had suffered since 1933 from recurring enteritis and perirectal inflammation for which he underwent numerous surgical procedures, including resection of most of the small bowel. Between 1939 and 1956 there had been a constant hypochromic anemia, for which about 521 pints of blood had been given. No blood was evident grossly in the feces and radiographic studies failed to demonstrate a source of bleeding.

Radiochromium studies showed that the patient was losing considerable blood and the surgical procedure that followed each of the two positive studies revealed a recurrent regional enteritis with ulceration as the source of the bleeding.

Cooper and Owen (J. Lab. & Clin. Med. 47: 65, 1956. Abst. in Radiology 68: 472, 1957) developed the following formula for determination of the amount of the bleeding:

$$\text{Blood lost (c.c.) per day} = \frac{\text{Radioactivity in 24-hour stool}}{\text{Radioactivity in 1 c.c. of blood}}$$

One chart.

J. S. ARAJ, M.D.
Toledo, Ohio

Autoradiographic Visualization of Radiocalcium and Radiosulfur in Vitro Uptake by Bone Tumors. Leonard F. Bélanger and Desmond Magner. Cancer 10: 1110-1113, November-December 1957. (University of Ottawa Faculty of Medicine, Ottawa, Canada)

In earlier studies demineralized sections of normal bones of several species of mammals, including man, have shown a preferential uptake of radiocalcium (Ca^{45}) at the epiphyseal plate after *in vitro* treatment with radioactive calcium chloride ($Ca^{45}Cl_2$). In contrast, similar sections of bone soaked in a solution of radioactive sulfuric acid ($H_2S^{35}O_4$) have revealed a preferential uptake by the fibrous outer periosteum and by the bone matrix. The cartilage and inner periosteum have shown practically no uptake. Variations from the normal pattern were detected in old age, in rickets, and in fluorosis.

Since bone tumors contain tissues at different stages of histogenesis, the *in vitro* treatment was applied to a group of human specimens (11 osteogenic sarcomas; 3 fibrosarcomas of bone; 1 osteochondrosarcoma; 1 chondrosarcoma; 1 osteochondroma), and radioautographs were obtained for purposes of comparison.

Bone-forming tumors revealed no uptake of calcium but a graded uptake of sulfur. It appears that the sulfate uptake in the bone-forming tissue is related to collagen and to collagen-producing cells.

Cartilage-forming tumors showed no uptake of sulfur but an extracellular uptake of calcium, apparently as a result of the cation-binding property of chondroitin sulfate.

Eight autoradiographs.

Studies with a Modified Collimator for Use with Scintillation Counter for Total Body Scanning. Joseph P. Concannon and Frances Bolhuis. Am. J. Roentgenol. 78: 855-863, November 1957. (J. P. C., Department of Radiation Therapy, Jefferson Medical College, 1025 Walnut St., Philadelphia, Penna.)

Scintillation counters with conventional, commer-

cially available, round collimators can readily detect the localization of radioiodine in areas remote from the thyroid where metastasis is known to exist. It is a much more complex problem to discover functioning thyroid carcinoma deposits that are unsuspected clinically with this equipment. These collimators see only relatively small areas and total body scanning is time-consuming and laborious. It is often necessary to take as much as twenty technician hours to obtain scanning records for five consecutive days.

The authors describe an inexpensive rectangular slit collimator which can be readily attached to conventional scintillation counters. It has a wide angle of "vision" laterally, which sees the whole width of the body, and a narrow angle of vision at 90° to the long axis. This improves the short axis resolution, with only 15 per cent loss of sensitivity at the same source-crystal distance. The time required to complete a total body scan with the rectangular slit collimator combination has been reduced to a half hour daily.

The collimator and counter are suspended from a motor-driven carriage on an aluminum rack supported over the length of a table by angle irons. The counter is connected through a linear amplifier to a rate meter and scaler in series. This discriminates against all pulses below 300 kv to reduce the counting rate due to background and scatter radiation.

To improve further the ability to detect laterally

placed sources, segments of lead were removed from either side of the crystal and an enlarged collimator was designed with an extended slot covering a 90° angle of vision around the crystal.

Comparative studies were made using the rectangular slit collimator and the conventional 4-cm. round collimator. These showed a 4:1 improvement in detection of laterally placed I¹³¹ sources and a 3:1 improvement in short axis resolution. The width seen by the new collimator at half height was 38 cm. as compared to 10 cm. with the commercial type collimator for a crystal-water phantom surface distance of 20 cm. This increases with the source-crystal distance. This improved short axis resolution is important in discriminating between two sources of radioactivity adjacent to each other. A 4-cm. separation between two point sources was the minimum necessary to produce two separate peaks when the slit collimator was 2 cm. away from the source; the round collimator required 7 cm. separation for the same collimator source distance. This relative inability of the round collimator to distinguish between adjacent sources was magnified considerably at increased source-collimator distances.

The rectangular slit collimator lends itself admirably to the application of the wedge filter principle.

Three photographs; 10 charts; 2 tables.

JOHN A. CAMPBELL, M.D.
Indiana University Medical Center

RADIATION EFFECTS—PROTECTION

Radiation Hazards. III. Radiation Protection in Diagnostic Procedures. Laurence L. Robbins. New England J. Med. 257: 922-926, Nov. 7, 1957. (Massachusetts General Hospital, Boston, Mass.)

Radiologists have been concerned with the inherent dangers of radiation for at least thirty-four years. It is unfortunate that the recent National Academy of Science Committee reports, which have been the subject of so much comment, failed to differentiate between trained radiologists and others using x-rays.

The author discusses the possibilities of radiation damage from various points of view and reaches the following conclusions:

"It behooves the radiologist and the consulting physician to work closely together to ensure that the proposed examination is indicated, that the likelihood of obtaining information is greater than the risk of radiation damage, that the patient is well prepared and that the equipment is designed and used only in the safest possible manner. Any unnecessary procedures involving ionizing radiation in healthy persons should be avoided.

"The use of fluoroscopes and makeshift equipment not supervised by trained radiologic personnel should be discouraged.

"The referring physician must act with judicial composure rather than be swayed by the hysteria of public half-knowledge. He must realize that the sick patient is not included in the assessment of the 10 r allowed the general population and that, when necessary diagnostic procedures are to be carried out, the patient should be reassured and his fears allayed."

This same issue of the *New England Journal of Medicine* contains a pertinent editorial "Radiation Hazards and Common Sense," emphasizing Dr. Robbins' plea

for a rational approach to this problem. Thoughtful analysis and careful consideration should take precedence over hysterical action.

Four tables.

ROBERT S. ORMOND, M.D.
Dearborn, Mich.

Radiation Hazards in the Field of Pediatrics. Meinhard Robinow and Frederic N. Silverman. *Pediatrics* 20: 921-940, November (Part II) 1957. (F. N. S., Elland and Bethesda, Cincinnati 29, Ohio)

This paper is a general survey of the problems of radiation exposure with particular emphasis on dangers to infants and children. All of the information is directed toward nonradiologists and is generally of a fundamental nature. The authors make many good points as to why radiation exposures tend to be larger and more important for the young as compared to adults. Very workable concepts of "permissible dose," nature and importance of radiation injuries, and methods of reducing radiation exposures are given. Comments are made on the full exploiting of diagnostic radiology balanced against the risk of radiation injuries.

Control in the use of radiations, according to the authors, should be along the lines of education of the physician first and the public second, rather than an attempted solution of the problem by legislation. Specific hazards in pediatric practice and in particular the dangers of "office fluoroscopes" are cited. Routine fluoroscopic examinations of the chest and of the skeleton are condemned.

It is concluded that "with good equipment properly installed and with sufficient attention to details of procedure and with regular monitoring, exposures to patients, attendants, and radiologists can usually be kept within limits of permissible dosage."

This paper contains a wealth of basic data and is strongly recommended for nonradiologists desiring accurate, instructive, and useful information on the problems of radiation exposures. A bibliography of about 100 titles is attached.

One table.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

A Survey of Radiation Exposure in Pediatric Practice. Mitchell R. Zavan and Peter J. Valaer. *Pediatrics* 20: 941-946, November (Part II) 1957. (M. R. Z., Kettering Laboratory, Eden and Bethesda Aves., Cincinnati 19, Ohio)

A study was made of the radiologic equipment of 44 Cincinnati pediatricians who use fluoroscopes in office practice. Work habits and safety features employed by the operators are analyzed. A time totalizer for summarizing time-of-use data for each of 29 fluoroscopic machines was installed. Each pediatrician using a fluoroscope was monitored for a period of one or two weeks with the use of a special laboratory coat containing spaces for ten pocket dosimeter chambers.

The results of the survey are presented in tabular form. It is evident that most of the machines produced excessive useful beam dosage rates. Safety measures with regard to field size limitation, filtration, cone protection, field-screen centering, etc., were found to be generally wanting. Most of the physician operators were able to keep weekly radiation exposures within the accepted permissible dose levels although 5 of 36 of those monitored obtained more than 200 mr to at least one site during the one-week survey period.

The conclusions are that the pediatricians' "low exposures were, however, not due to intrinsic protection nor necessarily to good technique but rather to infrequent use of the equipment." A plea is made for greater awareness of radiation hazards to patients and physicians and suggestions are offered as to how exposures can be appreciably decreased without compromise of diagnostic values.

Three photographs; 3 charts.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Radiation Effect on Intraocular Tissues in Radon Seed Treatment of Retinoblastoma. Edward Tamler, Frank C. Winter, and Paul Toch. *Arch. Ophthalmol.* 58: 647-654, November 1957. (Stanford University Hospital, San Francisco 15, Calif.)

The authors have had the opportunity of studying pathologically one eye of a child with bilateral retinoblastoma which had been treated by radon seed implantation along with a small amount (1,650 r calculated tumor dose, each eye) of external radiation. In each eye two radon seeds were sewn to the sclera, straddling the tumor with long axis parallel to the limbus; the posterior seed was 0.56 mc in strength; the other, 0.52 mc. The sites of radon seed attachment to the globe were very obvious on the pathological specimen and, therefore, the approximate radiation dose to various parts of the globe could be calculated and related to the histologic changes. In addition to the effect on the retinoblastoma, changes due to radiation were observed in the adjoining sclera and choroid, ganglion-cell layer, inner nuclear layer, and outer plexiform layer of the retina, retinal blood vessels, and lens.

Twelve figures.

Leukaemia, Amyloidosis, and Renal Vein Thrombosis in Irradiated Ankylosing Spondylitis. John B. Penfold and R. D. S. Rhys-Lewis. *Brit. M. J.* 2: 1034-1036, Nov. 2, 1957. (Essex County Hospital, Colchester, England)

This is a case report of leukemia developing in a patient who had received irradiation to the spine for ankylosing spondylitis. In addition there was thrombosis of the renal vein as a complication of amyloidosis. The diagnosis of ankylosing spondylitis was made in 1945, when the patient was thirty-two. He received 1,200 r to the spine from 1945 to 1948, and 1,000 to 1,500 r from 1948 to 1950. In 1954 a diagnosis of acute lymphoblastic leukemia was made.

ROBERT S. ORMOND, M.D.
Dearborn, Mich.

The Mechanism of Death Following Whole Body Radiation. Edith Paterson. *Brit. J. Radiol.* 30: 577-581, November 1957. (Christie Hospital and Holt Radium Institute, Withington, Manchester, England)

The mechanism of death following irradiation is different at different dose ranges and with different radiations. In this paper only penetrating radiation from an external source given in a relatively short time with doses in the LD-50 range is considered. High doses in the inevitably fatal range are eliminated and also those processes which shorten life by late production of leukemia or tumors, or by an aging process which may not be specifically a radiation effect. The study is limited to the effect on mammals.

In all mammals the curve of survival rate in the LD-50 range is steep, indicating that the dose difference between survival and death is small and that slight differences in the sensitivity of the animal determine its fate.

The common syndrome in the fatal case is encompassed within three weeks in all species. The animals show anorexia, loss of weight, diarrhea, hemorrhages, and necrotic lesions of the jaw. There is a dramatic drop in circulating blood cells and death appears to result from exhaustion. Animals that do not die show rapid recovery. Bacteremia does not seem to be a prime cause of death but contributes to the morbidity.

Hemorrhage clearly plays a part in the fatal outcome in some species. In monkeys the hemorrhagic tendency begins earlier in those animals which are going to die than in those which are to survive. The grouped platelet counts in monkeys are significantly lower during the postirradiation period in the fatally irradiated animals than in the survivors.

The responses of lymphocytes, polymorphonuclear leukocytes and eosinophils have no prognostic significance. The reticulocyte counts in the surviving animals, after showing a drop to nearly zero, rise slightly at about the eleventh day. This is so constant that it is the most reliable guide in foretelling the outcome of the irradiation in the individual animal. Red-cell counts in the survivors and nonsurvivors remain the same until about the eleventh day, when a steep and final fall occurs in the latter group.

The changes in the cells of the blood do not appear to be the fundamental cause of death which, however, does appear to be due to an effect on hemopoietic tissue. Injection of bone marrow even from different species can result in recovery of irradiated animals. The addition of undamaged stem cells improves survival.

The inference is that the lethal mechanism depends

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primarily on the exhaustion of certain cells of reticuloendothelial origin which must be responsible for systemic effects.

Three possibilities exist: (1) that the multiplication of the stem cells engineers survival by providing circulating cells; (2) that the same stem cells have functions other than the production of circulating cells; (3) that an unidentified cell is present which has these systemic functions.

Ten figures.

RICHARD P. STORRS, M.D.
Los Angeles, Calif.

Mechanism of Modification of Adrenal Function Caused by X-Irradiation. M. Föti. Fortschr. a. d. Geb. d. Röntgenstrahlen 87: 634-649, November 1957. (In German) (Röntgenabteilung des Hauptstädtischen Korányi-Krankenhauses, Budapest, Hungary)

The author has tried to correlate Selye's alarm reaction with the results of radiation therapy. According to Selye, the alarm reaction is divided into three parts: (1) adrenocortical hypertrophy with increased hormone production; (2) involution of thymus and lymphatics with eosinopenia; (3) gastroduodenal ulceration after prolonged dysfunction.

In 8 healthy persons the Thorn test (more than 50 per cent decrease of eosinophils after ACTH) consistent with adrenocortical mobilization was found positive from thirty minutes to twenty-four hours after x-irradiation of segments Th. 5-8 of the sympathetic chain. Similar results followed irradiation of the same segments of the spinal cord. The effect was absent with equal x-irradiation of the peripheral areas, was partially evident after irradiation of the gluteal area, and was reversed after irradiation of the brain stem. Direct irradiation of the adrenals had merely a depressing effect.

The most effective dose was 100 r. Doses above and below this value were found decreasingly effective. The threshold dose was 60 r. No effect was seen with so-called "stimulating doses" up to 30 r given to the areas mentioned above.

In 88 per cent of 100 cases of gastroduodenal ulcer the Thorn test was negative (less than 40 per cent decrease of the eosinophils after ACTH). It was positive in carcinoma of the stomach, pancreas, and uterus. Similar results were obtained with the modified Thorn test using adrenalin. The eosinopenia after irradiation was paralleled by an increase in ketosteroid excretion except in the ulcer cases, where it was less pronounced, sometimes indefinite. Pituitary irradiation decreased ketosteroid excretion but did not influence the eosinophil level. Brom medication inhibited the irradiation effects on ketosteroids and eosinophils, suggesting a neurohormonal mechanism.

Sympathetic irradiation caused the appearance of pressor substances, predominantly adrenalin, which together with increased ketosteroids causes eosinopenia.

The described phenomena are similar to the alarm reaction and are believed to play a role in the therapeutic effect of x-ray irradiation of the sympathetic chain in gastroduodenal ulcers.

Five figures; 6 tables. G. A. DOEHNER, M.D.
St. Vincent's Hospital, N. Y.

Significance of Electron Transfer in Bones for the Radiation Load of an Osteocyte. E. Krokowski and W. Rube. Fortschr. a. d. Geb. d. Röntgenstrahlen 87: 650-652, November 1957. (In German) (Strahleninstitut der Freien Universität Berlin am Städtischen

Krankenhaus Westend, Spandauer Damm 130, Berlin-Charlottenburg, Germany)

The older concept of Regaud, who coined the definition of osteoradionecrosis, was based on the assumption that damage to the osseous substance itself is responsible for the condition. New concepts, on the basis of experimental work, consider necrosis of the osteocytes as the responsible factor. This experimental contribution is concerned with comparative studies of osteocytes within a narrow osseous canal, at a depth of 3 mm., and osteocytes surrounded by water-equivalent material. With 200-kv x-irradiation the osteocyte surrounded by bone is exposed to 2.6 times more electrons than with exposure in an environment of water-equivalent material. At 100 kv a maximum is encountered, with the osteocytes receiving six times higher radiation when surrounded by osseous substances than in water-equivalent surroundings. At voltages below 100 kv, the higher absorption of bone results in a protective effect and the exposure of the osteocytes within osseous tissue is correspondingly lower. This study would suggest that the apparently higher sensitivity of osteocytes to radiation is explained by the "milieu" of the osteocytes which are embedded in small osseous canals.

Three figures.

G. A. DOEHNER, M.D.
St. Vincent's Hospital, N. Y.

Pharmacological Studies on Irradiated Animals. I. Scope and Methodology Exemplified by Effect of Nucleic Acids on Radiation Induced Mortality in Mice (Preliminary Results). F. Ellinger. Arch. internat. pharmacodyn. 109: 377-385, Feb. 1, 1957. (Pharmacology Division, Naval Medical Research Institute, Bethesda, Md.)

The first step in studies concerned with the effects of drugs, hormones, etc., on irradiated animals is the proper establishment of the biological significance of the irradiation dose applied. The mere statement of radiation source, physical factors of exposure, and dose expressed in physical units, though definitely necessary for the evaluation, is insufficient for this purpose because of the great variation in response of animal strains and species to a given amount of radiation. In particular, the correct determination of the percentage mortality produced in total-body irradiation is essential for pharmacological studies.

A number of factors contribute to radiation death: (1) toxic substances, which may originate from primary radiochemical reactions or may be the result of the release from radiation-damaged cells; (2) direct effects on vital organs of the body, especially on the blood-forming tissues; (3) the results of bacteremia due to lowered resistance to endogenous or exogenous bacterial invasion. At various dose levels and in different animal species the relative importance of these factors varies, and this must be kept in mind when planning research.

Two main lines of approach suggest themselves for pharmacological studies in irradiated animals: (1) the use of various drug concentrations on animals irradiated with one radiation dose, preferably the LD 50 for the particular species; (2) the use of one drug concentration in combination with at least two, preferably three, radiation doses.

The procedures outlined are illustrated by the presentation of preliminary data on the effects of ribo- and desoxyribonucleic acid as well as those of a spleen extract on radiation-induced mortality in mice.

The necessity of utilizing the entire lethal dose curve for the evaluation of drug effects is demonstrated.

Six charts.

Repopulation of Hematopoietic Tissues and Blood in Lethally X-Irradiated Mice by Homologous Bone-Marrow Cells. Ruth M. Merwin and Charles C. Congdon. *J. Nat. Cancer Inst.* 19: 875-884, November 1957. (National Cancer Institute, Bethesda, Md.)

In the experiments reported here the presence of homologous bone-marrow cells in the tissues of irradiated, treated mice was determined by the capacity of these tissues to initiate immunity when injected into nonirradiated mice of the same strain.

Mice were irradiated with 900 r to the whole body, and each was given an intravenous injection of a suspension of marrow cells from one femur of a mouse of another strain (C_3H). Tests were made for homologous (C_3H) cells in the marrow, blood, spleen, lymph nodes, and thymus of the irradiated recipients.

During the first four days after irradiation and the injection of homologous C_3H marrow, each femur contained a small number of homologous cells. Twelve to fourteen days after irradiation, the marrow had regained its normal cellularity and the antigenicity had increased. In thirty to sixty days each femoral marrow from the treated mice contained C_3H tissue equivalent to from one-fourth to the total marrow content of a femur from a normal C_3H mouse. These results, and those of others, demonstrate that the marrow of irradiated mice given marrow or spleen is repopulated by donor cells.

The spleen and lymph nodes, like the marrow, gave some positive tests after treatment up to four days. Tests on these tissues and on the thymus were consistently positive by the twelfth day. Blood, in the amount used, did not give consistently positive tests until after thirty days. The thymus glands and lymph nodes in sixty to one hundred days contained many homologous cells. Although it has been indicated by the work of others that injected spleen repopulates the lymph nodes and thymus of irradiated hosts, this is not yet proved for marrow injections. The findings reported here suggest that the thymus and lymph nodes are repopulated by lymphocytes derived from the donor; however, the evidence is not conclusive because of the possibility that the positive tests were due to homologous granulocytes rather than lymphocytes.

One graph; 2 tables. SYDNEY F. THOMAS, M.D.
Palo Alto, Calif.

Radiation-Induced Changes in Tissue Nucleic Acids: Release of Soluble Deoxypolynucleotides in the Spleen. Leonard J. Cole and Marie E. Ellis. *Radiation Res.* 7: 508-517, November 1957. (U. S. Naval Radiological Defense Laboratory, San Francisco, Calif.)

It has been known for many years that marked involution of spleen and bone marrow occurs after whole-body exposure to penetrating ionizing radiations in the lethal and sublethal dose range. This process is accompanied by marked losses of deoxyribonucleic acid (DNA) from these tissues, indicating that there is an actual loss of cells (*Cancer Res.* 14: 738, 1954. *Abst. in Radiology* 65: 488, 1955). The authors have investigated the changes in the deoxyribonucleic acid content of mouse spleen during the first few hours after lethal whole-body x-radiation exposure, as well as later, with particular emphasis on alterations in the state of combination of DNA with protein under these conditions.

Subsequent to whole-body irradiation of mice at the LD 100 dose level (810 to 850 r), a significant increase was found in the level of free deoxypolynucleotide as early as one hour postirradiation. The maximum level of 350 μ g of deoxypolynucleotide per spleen was attained at four to six hours postexposure, and then declined steadily so that by fourteen hours the level was essentially zero and remained so for the rest of the four-day period studied.

The maximum release of polynucleotide occurred at a time interval when the total spleen weight was decreasing and when the DNA-nucleoprotein content of the spleen was falling precipitously. In spleens of nonirradiated mice the deoxypolynucleotide content was 20 μ g per spleen—approximately 1 per cent of the total DNA in this tissue.

A new procedure of chemical fractionation of spleen was employed which makes possible the partition and chemical determination of deoxypolynucleotide in the presence of deoxyribonucleoprotein.

The question as to whether the radiation-induced formation of polynucleotide in the spleen is a primary radiation effect or is secondary to cell death is discussed.

Four figures.

Late Effects of Total-Body Roentgen Irradiation. II. The Influence of Fractionated and Single Radiation Doses on the Incidence of Tumors, Nephrosclerosis, and Adrenal Vacuolation in Wistar Rats During Various Periods of Postirradiation Survival. Baldwin G. Lamson, Raymond A. Meek, and Leslie R. Bennett. *Arch. Path.* 64: 505-521, November 1957. (Department of Pathology, University of California School of Medicine, Los Angeles 24, Calif.)

In the first paper of this series (Bennett *et al.*: *Radiology* 61: 411, 1953), the late effects in rats receiving 600 to 1,400 r whole-body roentgen irradiation under anoxia and surviving the acute postirradiation period were described. The present study concerns the late sequelae following 250 to 1,600 r total-body x-irradiation of young female Wistar rats under conditions of 5 per cent and 20 per cent oxygen. It was found that after doses of 500 r in either a 5 per cent or 20 per cent oxygen environment the onset of tumors was accelerated, the first multiple and malignant tumors being observed at five and one-half months postirradiation. In the nonirradiated controls neoplasms were absent prior to the thirteenth-to-eighteenth-month period, and multiple tumors did not appear prior to eighteen months.

Benign tumors of the ovary were found in 8 of 139 irradiated rats and were not observed in controls. Lymphomas and pituitary tumors were not significantly increased by irradiation under these conditions.

Preliminary observations, based on a very small number of animals, suggest that an 800 r dose in two 400 r exposures may produce a greater tumor-accelerating effect than a comparable single exposure.

A radiation dose-dependent nephrosclerosis was prevalent in Wistar and hybrid irradiated rats but not in the controls. After an inversely dose-dependent latent period a high incidence of nephrosclerosis appeared thirteen to eighteen and seven to twelve months after 800 and 1,000 r, respectively. Rats surviving only sixty days after 1,400 r showed no histologic evidence of renal injury.

Hypoxia during radiation exposure failed to protect against the later development of nephrosclerosis, although fractionation of the dose in a small group of ani-

mals may have exerted a protective influence. In irradiated rats with nephrosclerosis the kidneys and hearts were proportionately larger than kidneys and hearts from irradiated rats without nephrosclerosis.

The adrenal cortices of the irradiated groups frequently showed a nodular vacuolation that was rarely seen in nonirradiated rats of the same age.

Kidneys and hearts of irradiated and control animals were approximately equal in size.

Ten photomicrographs; 4 tables.

The Effects of Radiation on Extraction-Wound Healing in the Rat. Murray Stein, Luther W. Brady, and Antolin Raventos. *Cancer* 10: 1167-1181, November-December 1957. (A. R., 3400 Spruce St., Philadelphia 4, Penna.)

An investigation was carried out on the effects of irradiation on extraction-wound healing, with a comparison of these effects when irradiation is given at varying intervals after extraction.

Forty healthy male Wistar-strain rats, approximately 100 days old, were grouped into five experimental groups of 5 rats each and five control groups of 3 rats each. All animals had three upper right molars carefully extracted under pentobarbital anesthesia. Animals in experimental groups had a single gold tube, approximately 1 mm. in diameter and 4 mm. in length, containing 1 mc. of radon, implanted into the soft tissue immediately lateral to the extraction sites. The time interval for this procedure after extraction varied from group to group, and ranged from the day of extraction to twenty days thereafter.

It was found that, when irradiation is started shortly after extraction, the healing response is poor and slow. Surface closure of the wound is retarded, leaving a pathway open for infection. When irradiation is started eight days after extraction, even though the wound is not closed, there is less interference with healing, and, as the interval between extraction and irradiation is increased, the impairment to healing is further decreased.

For the radiation doses employed in these rats, it seems necessary to postpone irradiation until at least half the socket is filled with new bone in order to minimize retardation and interference with healing. In human beings, this stage of healing is not approached until several weeks have elapsed; although epithelial closure is usually achieved within two weeks, new bone formation has just started, and the socket does not completely fill with new bone until about the fifteenth week. In man, irradiating one to two weeks after extraction would be comparable, with regard to bony repair, to starting irradiation at zero to four days after extraction in the rat.

If the complications of radiation therapy for cancers in or about the oral cavity are to be minimized, one might conclude from the histological observations in this investigation that an interval longer than the usual one- to two-week period should be allowed between extraction of teeth and the beginning of treatment. However, the influence of radiation dosage and the dosage pattern, the volume of tissue irradiated, antibiotics, and other factors, including species difference, remain to be explored. Studies of the hazards of extraction after irradiation are also necessary, since it is possible that extractions performed after irradiation, with special precautions and the liberal use of antibiotics, may be less dangerous than irradiation too soon after extrac-

tion. If this were demonstrated, "prophylactic" extraction could be discarded.

Two roentgenograms; 10 photographs; 20 photomicrographs.

Histopathology of the Effect of Cortisone on the Irradiated Rat Lung. Charles C. Berdjis and Reynold F. Brown. *Dis. of Chest* 32: 481-492, November 1957. (R. F. B., Radiological Laboratory, Department of Radiology, University of California School of Medicine, San Francisco, Calif.)

The authors undertook to carry further a study of one of the authors (Brown: *Am. J. Roentgenol.* 75: 796, 1956) and to describe in detail the pulmonary changes following the use of cortisone before and after irradiation. A single dose of 3,000 r was administered to the right hemithorax of a number of male and female rats (250 kv constant potential; h.v.l. 0.47 mm. Cu; tissue dose rate about 125 r per minute; target-animal distance 70 cm.). Cortisone was administered to groups of animals three days before, fourteen days after, and twenty-eight days after irradiation. The surviving rats were sacrificed and autopsied ninety days following irradiation; the nonsurvivors were autopsied at death.

The histopathologic picture of the noncortisone treated rat was that of atelectasis. Pulmonary fibrosis was extensive, intermingled with inflammatory cells generally containing fragmented debris of bronchial walls and occasionally foreign-body giant cells. The lumens of some bronchi contained debris or degeneration cells. The trachea was involved but never obliterated. All phases of inflammation, including abscess formation, were observed. The alveoli were extensively involved in the inflammatory process. In two or three instances, hyalinized particles were intermingled with fibrous tissue. All degrees of bronchial obstruction were found associated with fibrosis, degenerative and inflammatory changes, metaplasia, and epithelial proliferation. Atelectasis, partial or total, depended upon the site of the obstruction.

In the three groups of cortisone-treated irradiated animals the histopathology varied. Each group presented two extremes, either a well aerated lung or a completely atelectatic lung. The well aerated lung in the cortisone treated rat showed less fibrous and fewer inflammatory changes than the normal control. The atelectatic lung in the cortisone treated rat showed a characteristic change: most of the alveolar spaces were dilated and filled with transudates. The edema-like fluid contained nothing or, occasionally, a few red cells, rare macrophages, and rare inflammatory cells. There was no fibrin in the fluid. The degree of atelectasis was augmented by hyperemia, stasis, and congestion. Inflammatory reaction was not marked. Fibrosis was moderate and limited about the bronchi and vessels. The peribronchial and perivascular lymphoid tissue was reduced.

The above changes were present when the cortisone was administered three days before irradiation. The changes were present but to a lesser degree when cortisone was administered two weeks after irradiation, and were still less pronounced following administration twenty-eight days after irradiation. In this last group, the overall microscopic picture was only slightly better than in the noncortisone treated group.

Six photomicrographs; 1 table.

HENRY K. TAYLOR, M.D.
New York, N. Y.

The Prevention of *Pseudomonas aeruginosa* Infections in Irradiated Mice and Rats. F. Wensinck, D. W. Van Bekkum, and H. Renaud. *Radiation Res.* 7: 491-499, November 1957. (Medical Biological Laboratory of the National Defence Research Council T. N. O., Rijswijk, Netherlands)

Widespread infection with *Pseudomonas aeruginosa* was found to be responsible for large numbers of early deaths in CBA and C57BL mice roentgen irradiated with 675 to 725 r. The infection originated from carriers and was propagated by fecal contamination of drinking devices. Sterilization of drinking bottles and elimination of permanent carriers led to the disappearance of the infection.

A rather unusual infection of mice by a *Pseudomonas*-carrying laboratory assistant with paronychia is reported.

In rats, early deaths were also found to be associated with *Pseudomonas* bacteremia. Sanitation of the rat colony was followed by a disappearance of *Pseudomonas* bacteremia and a considerable reduction of the incidence of early deaths.

The procedures leading to effective control of infection are time-consuming and must be strictly adhered to. In the authors' experience, however, careful sanitation as well as bacteriological postmortem examination are essential for obtaining reliable results from experiments involving the irradiation of animals.

Two figures; 3 tables.

On Changes in Oxygen Uptake of Brain Tissue After X-Irradiation. A. D. Snezhko. *Biophysics* (English Translation of *Biofizika* by Pergamon Press) 2: 70-82, 1957. (Institute of Biological Physics, Academy of Sciences of U.S.S.R., Moscow, U.S.S.R.)

An attempt has been made to determine to what extent the deficit of oxygen in brain tissue following irradiation is the result of changes in the blood circulation or of changes in actual tissue respiration. Three experiments were carried out, each with six rabbits. The first group of animals received 1,000 r and 1,100 r whole-body irradiation. In the second group, only the heads were exposed, receiving 3,000 r and 1,100 r. In the third group 2,500 r and 1,100 r were delivered to the abdominal region between the lower half of the thoracic vertebrae and upper half of the lumbar vertebrae. Physical factors were 170 kv, 6 ma, 0.5 mm. Cu and 0.75 mm. Al filtration; dose rate 40 r/min.

Exposure of the entire body or head resulted in increased oxygen tension in the brain of the rabbit, beginning almost immediately after irradiation and lasting for several hours. Taking into account the fall in blood pressure and the reduction in mass of circulating blood following irradiation, the author concludes that irradiation directly depresses respiratory activity in the cortical tissue of the brain.

Irradiation of the abdomen of the rabbit resulted in a reduced oxygen tension in the brain, lasting for a few hours after the end of exposure. This indicates a reflexly produced increase of oxygen consumption in the brain.

The changes in the oxygen tension produced in the brain by all forms of irradiation showed a phasic character.

There were characteristic changes in the rhythmic fluctuations of the oxygen background level.

In the final stages of radiation sickness, the response of the oxygen tension in the brain to added oxygen in the inhaled air is prolonged.

Eight figures; 4 tables.

Effect of Ionizing Radiations on Fungi in Vitro. George M. Lewis, Walter J. Schmidt, and Mary E. Hopper. *Arch. Dermat.* 76: 601-606, November 1957 (66 E. 66th St., New York, N. Y.)

Two species of pathogenic dermatophytes, *Microsporum gypseum* and *Trichophyton mentagrophytes*, were subjected to various amounts of roentgen irradiation. The fungi were then inoculated on dextrose agar, and after five weeks biopsies were done on the colonies. Four successive generations were studied in a similar manner. The results revealed a marked resistance to the insult of intensive irradiation. Gross changes in the colonies were minimal or absent. Microscopic findings indicated a speeding-up of maturation in *M. gypseum*, as evidenced by more rapid development of a core. In *T. mentagrophytes* the core was narrow, deeply stained, and poorly defined. There was only minimal evidence of degenerative changes. In some of the macrospores of *M. gypseum*, the septa were prominent and some of the compartments were swollen. For both strains, lack of reduction of spores was notable.

Seven illustrations.

On an Anomalous Reaction Caused by Small Doses of Radiation. N. V. Luchnik. *Biophysics* (English translation of *Biofizika* by Pergamon Press) 2: 90-98, 1957. (Biological Institute of Ural Filial, Academy of Sciences of U.S.S.R., Sverdlovsk, U.S.S.R.)

A study was made of the reaction caused by small doses of radiation in the pea. The seeds were soaked for twenty-four hours in solutions of uranium fission products. The solution employed acted as a practically pure source of beta radiation. The experiments were conducted within very wide limits of concentration—the highest being 2,560 times greater than the lowest—so that the results for high concentrations and those for low concentrations have to be considered separately. The dependence of the number of anomalous mitoses (bridges, fragments) on the concentration gives a super-saturated curve, resolvable into two components.

Theoretical analysis shows that such curves may be obtained only with nonhomogeneous material. The action of several agents producing the same effect on a homogeneous population gives simple exponential or S-shaped curves. The author believes that the experimental results may be explained on the assumption that the sensitivity of the cells undergoes cyclic changes. On prolonged irradiation, a greater number of cells are irradiated in the hypertensive state.

The possibility of the action of low-energy agents (having a lower energy than the energy of activation) is analyzed. In this instance the energy of the agent is added to the energy of thermal oscillations, decreasing the index of power in the Arrhenius-van't Hoff equation. In the case of joint action of agents of high energy (ionization) and of low energy (excitation or free radicals), composite curves must be obtained. The results of Bonnier (*Brit. J. Radiol.* 25: 180, 1952) may thus be explained, and an experimental check of the hypothesis is proposed.

Two figures.

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